

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PROPOSED APPROPRIATION LANGUAGE

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95-91), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), performed under the minerals and materials science programs at the Albany Research Center in Oregon [\$362,403,000], \$383,408,000 to remain available until expended: Provided, that no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas.

Explanation of Change

Reflects a total FY 1999 budget request of \$383,408,000 including the Materials Partnership program transferred from the Department of Interior, Bureau of Mines in FY 1996.

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(Tabular dollars in thousands, Narrative in whole dollars)

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PROGRAM MISSION

Program Mission

The mission of the Fossil Energy (FE) Research and Development (R&D) program is to stimulate sustainable development and utilization of the nation's fossil fuel resources and technologies to assure an ample, secure, clean and low cost domestic supply of energy. This mission will be executed in a way that: assures U.S. global leadership in fossil energy technology; protects the local, regional and global environment; merits public trust; promotes public-private partnerships; creates U.S. jobs; and, contributes to a stronger economy.

Program Overview

The U.S. is reliant on fossil fuels for about 85% of the energy it consumes. Many forecast that relatively low fossil fuel prices and high U.S. reliance on these fuels will continue for decades. Accordingly, a key goal of the Department's fossil energy activities is to ensure that economic benefits from market-priced fossil fuels and a strong domestic industry that creates export-related jobs do not come with unacceptable environmental costs or energy security risks.

To be successful, Federally funded and developed technologies and related analysis need to be transferred into commercial applications. This will be accomplished through joint partnerships with industry utilizing a variety of mechanisms including cost-shared contracts, targeted outreach activities, and cooperative research and development agreements with the Department's Federal Energy Technology Center and National Laboratories.

In FY 1999, \$109.6 million is requested for natural gas activities, of which \$24.4 million is related to gas supply R&D, and the remainder to gas power applications. EIA, in its 1998 Annual Energy Outlook (AEO98), projects a 46 percent increase in domestic natural gas consumption by 2020, with two-thirds used for electric power generation. This will require increasing amounts of gas to be

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drawn from parts of the vast domestic resource base that are not currently economical to recover due to the geological setting, quality of the gas, or location relative to infrastructure. The gas program focuses on technical and market needs, and is closely coordinated with efforts by the Gas Research Institute (the research arm of the natural gas industry), other industry energy research, and related research in DOE's Office of Energy Efficiency and Renewable Energy and Office of Energy Research. The program has been developed using a systems approach that spans the entire natural gas fuel cycle from reservoir to end use.

FY 1999 will continue a strong emphasis on development of advanced, super-clean, high efficiency power generation systems utilizing our abundant natural gas resource. These systems hold the promise of significant greenhouse gas reductions, both in natural gas applications and as part of advanced coal power cycles. In FY 1999, under the Advanced Gas Turbine Systems Program, DOE will continue the turbine systems testing phase. Under the Fuel Cells Program, system and stack improvements and cost reduction through improved components and new concepts will continue for distributed and on-site applications.

The natural gas fuel supply activities seek to ensure long-term availability of natural gas at reasonable prices and are carried out under the areas of exploration and production, storage, processing and environment. Under the exploration and production program, activities continue primarily in the development and application of more cost effective advanced drilling technology, as well as resource assessment methodology and reservoir characterization technology to enhance the economic producibility of large volume, low permeability reservoirs. Technology advancement in exploration and production activities is needed to ensure that adequate natural gas reserves and deliverability will be available to meet the increasing demand for natural gas. FY 1999 activities will include initial diagnostics and characterization efforts to assess gas hydrates, and assessment for revitalization of stripper gas wells. Storage activities focus on technologies and engineering techniques designed to increase the efficiency and reliability of natural gas during periods of high natural gas demand. New and advanced operational, diagnostic, and analytical technologies and advanced gas flow measurement systems are the key to increasing storage system deliverability, capacity, and mitigating unaccounted-for gas losses of storage inventory.

Gas processing activities focus on development of more efficient processes to upgrade the estimated 300 Tcf of domestic natural gas resources that are low-quality and do not meet pipeline standards. Gas-to-liquids conversion efforts are developing promising technology to utilize shut-in, remote gas resources in Alaska and the Gulf of Mexico. Another key objective of this technology program is to provide clean transportation fuels that are competitive with oil-based fuels.

In FY 1999 \$50.2 million is requested for petroleum activities. Oil R&D activities seek to enhance energy security through increased

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domestic production, as well as helping the U.S. to be a responsible steward of its oil resources. Marginally economic wells with high remaining resource potential, but low profitability, are being abandoned at an alarming rate. The cumulative impact is that tens of billions of barrels of oil may never be economically producible. The combined impact of FE R&D could contribute toward preserving the availability of these resources, extending reservoir life, and increasing domestic production by nearly 370 million barrels/year (including gas-to-liquids) by 2010, offsetting equivalent amounts of imports.

Oil R&D includes supporting research and field demonstrations focused on reservoir life extension. The program funds research in the following areas: the development of imaging and diagnostic systems for exploration; reservoir characterization; advanced drilling, completion, and stimulation systems; extraction; and an aggressive technology transfer program to convey to industry methods for extending reservoir life. These technologies are expected to increase annual oil production by 109 million barrels in 2000, save 25,000 high paying jobs by 2005, and contribute \$14.5 billion in additional revenues by 2010.

Environmental research activities, which are conducted under both the gas and oil programs, will contribute credible scientific information and advanced technologies to address high priority environmental issues that have been identified by industry and state and federal regulators. In FY 1999, the program will focus on detection and control of air emissions from gas and oil equipment and facilities, treatment of produced water to meet environmental standards, remediation of soils that have been contaminated with hydrocarbons or produced water, treatment and disposal of wastes containing naturally occurring radioactive materials, underground injection of produced water, and other approaches to manage oil and gas field wastes. The program will also implement, together with states and industry, on-line expert systems for environmental permitting and reporting that can save both producers and state regulators time and money. Through these activities with state governments and industry, the gas and oil environmental program can contribute toward decreasing cumulative industry compliance costs, between now and 2010, by as much as \$16 billion, increase gas production by 900 billion cubic feet per year, retain production of up to 60,000 barrels per day of oil that would otherwise be abandoned, increase federal and state revenues by over \$8 billion, and add 11,000 jobs to the economy by 2010.

Key inputs for directing the future of FE gas and oil activities are survey results from the National Petroleum Council study "Research, Development, and Demonstration Needs of the Oil and Gas Industry," the Petroleum Technology Transfer Council Needs Assessment, and inputs from key stakeholders. These surveys identify potential high benefit R&D areas, considering the near- and long-term needs of both the supply and utilization sectors, where industry respondents, for a variety of reasons, do not believe the oil and gas industries will make adequate progress on their own. Additionally, the President's Committee of Advisors on Science and Technology (PCAST),

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in its November 1997 report "Federal Energy Research and Development for the Challenges of the Twenty-First Century," recommended FE program support for: 1) technology transfer and cost-effective demonstrations to help maintain production from mature and marginal regions of domestic production; and 2) foundation building R&D in universities and National Laboratories to help maintain the leadership of the United States in oil and gas technologies. The report further states that the oil and gas programs reduce the balance of payments due to oil imports, prevent premature abandonment and, therefore, loss of some resources, and help maintain revenue streams to Federal and State treasuries from taxes and royalties.

The FY 1999 request for coal is \$118.5 million. The coal program responds to the energy and environmental demands of the post-2000 domestic market, including increasing international pressure to reduce greenhouse gas emissions, and helps U.S. industry to respond to a currently large and growing export market, while contributing to national energy security. In response to these priorities, the coal program is focused on three goals. The first is to develop progressively higher efficiency and cleaner power generation systems with 10-20% lower busbar electricity costs, and ultimately evolve into a "Vision 21" fleet of new power and energy plants with near zero levels (including CO₂) of pollutants. The second goal is to develop super-clean emission control systems for SO₂, NO_x (70% to 90% reduction at a fraction of today's cost), air toxics (90% reduction), and particulate matter that can be applied to existing plants. The third goal is to develop economically competitive technologies for the production of alternative transportation fuels and chemicals.

Significant progress towards achieving these goals will be made in FY 1999 through a number of ongoing projects in the Clean Coal Technology Demonstration Program. Three advanced integrated gasification combined cycle (IGCC) facilities will be operating to provide clean power with new technology. A second generation pressurized circulating fluidized bed combustion facility will be under construction and the data needed to evaluate the comparative merits of nineteen advanced environmental control devices just recently demonstrated will be available. Finally, the first demonstration plant to produce alternative transportation fuels and chemicals by means of the innovative liquid phase methanol process has started operation, reaching design production within a few days of initial operation. The Coal R&D Program is linked to the Clean Coal Technology Program by development, delivery, and refinement of subsystems critical to the technology system demonstrations; and continuing research in key areas that serve to support problem solving during demonstration and enhance the economics and environmental performance needed for market entry. Also, the advanced coal-fueled power system development effort is coupled to that of the Advanced Turbine and Fuel Cell development in that achievement of ultimate performance objectives for coal-fueled systems will require these components.

The major share of FY 1999 funding in coal R&D will be focused on advanced power generation systems (i.e., advanced pulverized

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coal-fired systems, indirect-fired cycles, IGCC, and pressurized fluidized-bed (PFB) combustion) that can achieve efficiencies in the 42-45 percent range in the 2000-2005 period, and will provide the engineering foundation for system efficiencies in the 55-60 percent range. These improvements could reduce CO₂ emissions by over 40 percent compared to current coal-fired systems. In the advanced pulverized coal-fired program, the Low Emissions Boiler System (LEBS) will enter Phase IV, the last project phase, where the focus is to provide data needed to make LEBS commercially available. The High Performance Power System (HIPPS) in the indirect-fired cycle program will continue, at a reduced level, the engineering development phase. Long term testing will continue on the transport reactor train and hot gas particulate controls for IGCC at the Wilsonville Power Systems Development Facility (PSDF). Operation of a product development unit for desulfurization will continue along with R&D and testing of other novel and advanced sulfur sorbents and systems for IGCC. Also at the Wilsonville facility, operation of an advanced PFB pilot scale project will continue and testing of a PFB pilot scale second generation system will be initiated. Systems and materials testing and evaluation for performance improvement and cost reductions for PFB will also continue.

A series of environmental protection initiatives from the Environmental Protection Agency are expected to impact fossil energy systems. These initiatives include stringent new National Ambient Air Quality Standards for fine particles and ozone, limitations on emissions contributing to regional haze, further reductions in NO_x emissions from powerplants to meet current ozone standards, and limitations on potentially hazardous air emissions from coal-fired powerplants. The time frame for implementing these regulations will be between 2005 and 2010, and EPA has indicated that the primary target for control will be existing coal-fired powerplants. As a result, FY 1999 activities include a rapid scaleup of efforts to introduce lower cost technologies which are effective in controlling NO_x, SO₂, and mercury, and which are appropriate for retrofit to existing powerplants. In the case of NO_x and SO₂, the primary objective of the R&D will be cost reduction. For mercury, no practical control technology now exists to significantly mitigate emissions from powerplants, so the focus is on both effectiveness and cost. In addition, there may be opportunities for innovative approaches which address two or more of these pollutants simultaneously. Finally, it should be noted that there are significant overseas markets for lower cost technologies to address NO_x and SO₂, particularly in Asia.

Significant potential benefits can be realized from achieving the power systems and environmental systems goals. Reductions in the cost of electricity can amount to \$5 to \$15 billion in savings per year to consumers. The global sales of U.S. industry's advanced power systems can reap revenues of \$200 billion based on only 20% of the projected \$1 trillion world power equipment market, and could support more than 3 million jobs-years over three decades. Achieving the environmental goal will lower NO_x and hazardous air pollutants by 70 to 90 percent while reducing existing and future environmental compliance costs, thereby producing savings of over \$7

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billion per year to the U.S. industry.

Advanced Clean Fuels Research focuses on technologies for producing clean, economically competitive coal-derived liquids. The aim is to develop environmentally superior processes for transportation and boiler (utility, industrial and commercial application) fuels and chemical feedstocks which can compete with petroleum crude at \$20 per barrel by the year 2010. The AEO98 reference case projects that in 2010 imported oil will be priced at about \$21 per barrel, and the U.S. will import 60 percent of its petroleum. If the availability of a potentially large-scale, alternative supply of liquid fuels were able to depress oil prices by \$0.50/barrel, the yearly cost saving to U.S. consumers in 2010 would be over \$3.5 billion. Categories within this decision unit include: Coal Preparation, Direct and Indirect Liquefaction, and Advanced Research and Environmental Technology.

This program has been restructured in FY 1999. Activities with intermediate term impacts are being carried out cooperatively with the Office of transportation Technologies (EE) and the Office of Oil and Gas, Emerging Processing Technology. The focus is on the development of premium fuels that can be used with new diesel engines in light trucks and sports/utility vehicles to achieve much greater system efficiency with significantly reduced emissions. Activities with longer-term payoffs will be carried out under the Advanced Research activity and emphasize conversion of coal directly, or in combination with other domestic feedstocks and waste materials, to competitively-priced transportation liquids that are environmentally (including greenhouse gases) acceptable. Advanced processes will be incorporated to facilitate liquefaction processes, such as dense-ceramic membranes, which are being developed in the oil and gas R&D program.

A longer term focus of the Coal and Power System Program is to integrate the program goals towards a "Vision 21" concept as the next logical step that will allow the Nation to realize the full potential of its abundant fossil fuel resources while addressing climate change concerns. The concept of Vision 21 has been endorsed in the November 1999 PCAST report, and supported by the National Research Council and other stakeholder groups. Vision 21 Energy-Plexes comprise a portfolio of fuel-flexible systems and modules capable of producing a varied slate of high-value fossil fuels, (or on combination with other opportunity fuels or feed-stocks) commodities and/or electricity tailored to market demands in the 2010-2015 time frame. Distinguishing features of the Vision 21 fleet are (1) capability to produce cheaper electricity at efficiencies over 60 percent; (2) near zero pollutants to meet more stringent emissions standards (less than one-tenth of New Source Performance Standards for criteria pollutants) at a lower cost; (3) options for no net CO₂ emissions; (4) fuel flexible (coal plus other opportunity fuels); and (5) a flexible set of integrated modules configured to meet a range of market applications and capable of producing an array of high-value commodities (such as chemicals, high-quality

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steam, liquid fuels, and hydrogen) at competitive prices in a free market.

FY1999 initiatives tied to Vision 21 will include the restructured Advanced Clean Fuels Research program, activities in advanced research and advanced power systems, and increased efforts to develop moderate-cost carbon sequestration approaches. Advanced research activities include materials research and development of membranes that can inexpensively separate oxygen and hydrogen. Power systems R&D will focus on technical issues associated with achieving ultra-high efficiencies by integrating advance components such as a gasifier, fuel cell and turbine. Sequestration research will be done in collaboration with other parts of the Department, other countries, and industrial firms, and pursue a balanced set of approaches to establish both the environmental acceptability and the required technical and economic performance. These initiatives will be carried out primarily at national laboratories and through competitive contracts with industry.

In the area of environment, safety and health (ES&H), significant compliance deficiencies have been identified at the FE R&D facilities, as well as at off-site locations where R&D projects were sponsored. In addition, FE is responsible for correcting ES&H problems at the Albany Center, a former U.S. Bureau of Mines facility that was transferred to FE in 1997. FY 1999 funding at a level of \$ 11.0 million is targeted at corrective actions to ensure that the FE R&D facilities are operating in compliance with Federal, state and local ES&H requirements, and that the environmental contamination associated with the on-site operations and off-site locations is remediated. The major share of funding will focus on environmental remediation, indoor air quality and ventilation, industrial safety, emergency preparedness, fire protection, control of toxic and hazardous materials, and protection of water and air quality. A sustained commitment to ES&H is an important factor in retaining public trust in the conduct of FE activities.

The FY 1999 request for Program Direction and Management Support is \$67.0 million. The FY 1999 request recognizes the important role of the Federal Energy Technology Center in the FE program and the need to fund the sites at a level consistent with program goals. FE also promotes the development of interfuel competition and markets for U.S. natural gas and electricity through regulation of natural gas imports and exports and electricity exports by the Fuels Program.

Relative to international activities, FE is taking steps to ensure that the U.S. benefits directly from cooperative research with foreign governments and multilateral institutions as well as enhanced international regulatory coordination. FE is also working with other Departmental groups, Federal agencies, international organizations and private sector companies to promote the export of domestic fossil fuel technology.

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Consistent with the R&D goals of the Department, the materials program at Albany, which was formerly associated with the U.S. Bureau of Mines, is being directed at research which will conserve materials produced from minerals. The program will be coordinated with not only Fossil Energy materials R&D but also the materials research at DOE's Office of Energy Efficiency and Renewables and Office of Energy Research. With this coordination, the Department will avoid a duplication of effort and also take full advantage of the unique expertise at the Albany Center which has focused on the full life cycle of materials. The program at Albany will stress full participation with industry and emphasize cost sharing to the extent possible.

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PROGRAM FUNDING PROFILE

<u>Sub-program</u>	<u>FY 1997 Enacted</u>	<u>FY 1998 Enacted</u>	<u>FY 1999 Base</u>	<u>FY 1999 Request</u>	<u>Program Change Request vs. Base</u>	
					<u>Dollar</u>	<u>Percent</u>
Coal						
Advanced Coal Fuels Research						
Operating Expenses	\$15,831	\$15,844	\$15,844	\$14,928	\$-916	-6%
Advanced Clean/Efficient Power Systems						
Operating Expenses	\$67,759	\$73,990	\$73,990	\$91,538	\$17,548	24%
Advanced Research and Technology Development						
Operating Expenses	\$17,352	\$17,579	\$17,579	\$23,579	\$6,000	34%
Subtotal Coal	\$100,942	\$107,413	\$107,413	\$130,045	\$22,632	21%
Gas						
Natural Gas Research						
Operating Expenses	\$68,457	\$71,000	\$71,000	\$67,357	\$-3,643	-5%
Fuel Cells						
Operating Expenses	\$48,804	\$40,210	\$40,210	\$42,200	\$1,990	5%
Subtotal Gas	\$117,261	\$111,210	\$111,210	\$109,557	\$-1,653	-1%

PROGRAM FUNDING PROFILE - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

<u>Sub-program</u>	<u>FY 1997 Enacted</u>	<u>FY 1998 Enacted</u>	<u>FY 1999 Base</u>	<u>FY 1999 Request</u>	<u>Program Change Request vs. Base</u>	
					<u>Dollar</u>	<u>Percent</u>
Petroleum						
Oil Technology						
Operating Expenses	\$45,184	\$48,569	\$48,569	\$50,166	\$1,597	3%
Subtotal Petroleum	\$45,184	\$48,569	\$48,569	\$50,166	\$1,597	3%
Program Direction and Management Support						
Operating Expenses	\$68,710	\$66,766	\$66,766	\$67,031	\$265	0%
Plant and Capital Equipment						
Construction	\$2,000	\$2,532	\$2,532	\$2,600	\$68	3%
Fossil Energy Environmental Restoration						
Operating Expenses	\$13,054	\$12,935	\$12,935	\$11,000	\$-1,935	-15%
Cooperative Research and Development						
Operating Expenses	\$5,432	\$5,840	\$5,840	\$5,836	\$-4	0%
Fuels Program						
Operating Expenses	\$2,188	\$2,173	\$2,173	\$2,173	\$0	0%
Advanced Metallurgical Processes						
Operating Expenses	\$5,000	\$4,965	\$4,965	\$5,000	\$35	1%
Use of Prior Year Balances and Other Adjustments						
Operating Expenses	\$-1,128	\$0	\$0	\$0	\$0	0%
Total	<u>\$358,643</u>	<u>\$362,403</u>	<u>\$362,403</u>	<u>\$383,408</u>	<u>\$21,005</u>	<u>6%</u>

PROGRAM FUNDING PROFILE - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

<u>Sub-program</u>	<u>FY 1997 Enacted</u>	<u>FY 1998 Enacted</u>	<u>FY 1999 Base</u>	<u>FY 1999 Request</u>	<u>Program Change Request vs. Base</u>	
					<u>Dollar</u>	<u>Percent</u>
Summary						
Operating Expenses	\$356,643	\$359,871	\$359,871	\$380,808	\$20,937	6%
Construction	<u>\$2,000</u>	<u>\$2,532</u>	<u>\$2,532</u>	<u>\$2,600</u>	<u>\$68</u>	<u>3%</u>
Total Program	<u>\$358,643</u>	<u>\$362,403</u>	<u>\$362,403</u>	<u>\$383,408</u>	<u>\$21,005</u>	<u>6%</u>
Staffing (FTEs)						
Headquarters	116	114	114	114		
Field	<u>555</u>	<u>569</u>	<u>569</u>	<u>569</u>		
Total Staffing	<u>671</u>	<u>683</u>	<u>683</u>	<u>683</u>		

Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1997)

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SUMMARY OF CHANGES

FY 1998 Appropriated	\$362,403
- Non-Discretionary	<u>0</u>
FY 1999 Base	\$362,403

Advanced Clean Fuels Research

- Coal Preparation - The decrease provides for continuing research on methods for coal cleaning to produce premium fuels, reduction of air toxic precursors, and high efficiency processes development	-217
- Direct Liquefaction - The decrease provides for continuing bench scale research, at a reduced level, on advanced liquefaction and waste/coliquefaction studies	-3,016
- Indirect Liquefaction - The increase provides for continuing oxygenate catalyst and reactor studies, and syngas polishing and integrated studies	1,277
- Advanced Research and Environmental Technology - The increase continues research on coprocessing of coal with waste material, improved methods for characterizing coal-derived liquids and advanced catalytic approaches to coal liquefaction, developing concepts for producing and studying carbon materials, laboratory scale research on producing liquid transportation fuels and chemicals, while supporting the Consortium for Fossil Fuel Liquefaction Science	1,040

Advanced Clean/Efficient Power Systems

- Advanced Pulverized Coal-Fired Powerplants - The decrease provides for the continuation of Phase IV construction and operation of the LEBS proof-of-concept facility	-1,112
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SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

- Indirect Fired Cycle - The increase provides for the refocus of the program to those components and subsystems that are part of the Vision 21 plant	1,073
- High Efficiency - Integrated Gasification Combined Cycle - The increase provides for continued development of the transport-bed gasifier at the Wilsonville Power Systems Development Facility; continued PDU operation of the novel fluid-bed desulfurizer; continued testing of advanced sorbents for removal of sulfur and R&D to develop advanced direct and simplified sulfur recovery concepts; continued work on the development of an improved air separation technology; investigate CO2 recovery and utilization technologies; and conduct innovative approaches for improving plant efficiencies for power and fuels production, thereby reducing greenhouse gas emissions in support of global climate change initiatives	11,158
- High Efficiency - Pressurized Fluidized Bed - The decrease provides for continued advanced particle control testing of improved particle removal devices; in-house PFB support; and research on improving advanced PFB environmental performance	-3,237
- Advanced Research and Environmental Technology - The increase provides for continued efforts to investigate and/or improve the capabilities of technologies to recover, reuse, and/or store greenhouse gas emissions from coal-based energy systems; activity in the areas of super clean systems, including control technologies for CAAA Title IV, Phase II regulations and pending PM2.5 standards compliance; fine particulate control/air toxics; and CO2 sequestration	9,666

Advanced Research and Technology Development

- Coal Utilization Science -The increase provides for the redirection of research toward the Grand Challenges of the Virtual Demonstration Plant and CO2 capture, sequestration, and offset, in support of the Vision 21 concept of a power and fuels complex	2,300
- Coal Technology Export - The decrease provides for continued support for coal and technology export programs and promotion initiatives; assists in trade missions and other activities to promote the export of clean coal technologies; and continues the coordination of all FE international related crosscutting activities	-2

SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

- Bioprocessing of Coal - The increase provides for the demonstration of the biological conversion of coal synthesis gas to ethanol at the pilot scale; and continues research on ongoing bioprocessing efforts	997
- University Coal Research - The increase continues support for university research and undergraduate internship programs	932
- Materials - The increase provides for continued program development efforts on high temperature intermetallics, ceramic composites and high temperature filters, membranes, and solid state electrolyte functional materials.	1,000
- Environmental Activities - The decrease continues environmental analyses of air and water quality, solid waste disposal, toxic substance releases, and global climate change	-19
- Technical and Economic Analysis - The increase continues studies supporting multi-year planning, FE strategy, and program formulation, provides analytical support for fossil related Energy Policy Act implementation; supports state and regional efforts to develop energy analysis capability	225
- International Program Support - The increase continues analysis, studies and technical evaluations of ongoing and planned bilateral and multilateral activities; and continues support for international initiatives that leverage fossil energy resources	499
- HBCUs, Education and Training - The increase continues efforts to accelerate workforce diversity in fossil fuel related technologies	68

Natural Gas Research

- Exploration and Production - The decrease continues a cooperative drilling program with industry; research in low-permeability reservoir field demonstrations; development of a natural gas data base and atlases; gas technology transfer efforts; initiate diagnostics to locate gas hydrate deposits in offshore environments; and conduct engineering assessments to determine candidate areas for restimulation tests	-500
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SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

- Delivery and Storage - The increase continues a cooperative program with industry to develop deliverability and enhancement technology, advanced storage concepts, and advanced gas measurements 7
- Advanced Turbine Systems - The decrease continues the ultra high efficiency gas turbine technology program; full-scale testing on critical components; development of high efficiency gas turbines for electric power generators; and initiation of site erection and preparation for full speed test -2,000
- Emerging Processing Technology Applications - The decrease continues assessments of gas conversion feasibility; support for an international center or information on natural gas technologies; and research in low-quality gas upgrading -500
- Effective Environmental Protection - The decrease continues environmental research including data analysis, risk assessment, application of advanced research, and technology development. Continues outreach and technology transfer program on environmental issues related to natural gas. Continues pilot test of NORM treatment and disposal alternatives -650

Fuel Cells

- Advanced Research - The decrease continues research on molten carbonate and solid oxide systems and provides funding for two cooperative research and development efforts -10
- Fuel Cell Systems Development - The increase continues system/stack improvement efforts; continues supporting assessments and studies; and continues industry cost-shared cost reduction and product improvement research 2,000

Oil Technology

- Exploration and Production Supporting Research - The increase continues efforts in analysis and planning, extraction research, reservoir characterization, technology transfer, exploration and drilling and national laboratory/industry partnership and related supporting research 911

SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

- Recovery Field Demonstrations - The increase provides for competitively selected cost-shared projects to extend reservoir life in Class 1 and 2 projects; continues Class 3 research; and provides for research on increased production from marginal wells 1,747
- Effective Environmental Protection - The increase expands efforts in program planning and analysis, environmental regulatory review, risk assessment, and technology development and produced water research 4,459
- Emerging Processing Technology Applications - The decrease eliminates fundamental research in petroleum chemistry and thermodynamics to effect oil composition changes; and continues joint efforts with industry/universities/national laboratories on developing concepts for heavy oil upgrading -5,520

Program Direction and Management Support

- Headquarters Salaries and Benefits - The increase provides for 95 FTEs at Headquarters. This staff implements and communicates policy to the FETC, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans, and monitors work progress 42
- Headquarters Travel - The increase provides funds for travel in support of the activities stated above. Both domestic and international travel are conducted 20
- Headquarters Contract Services - The increase provides for contractual services that are generic to the entire FE program. Included are items such as computer services, technical and management support services, E-mail and LAN requirements, computer timesharing/housekeeping, and the working capital fund which provides overhead expenses 378
- Field Salaries and Benefits - The increase provides funds for 340 FTEs at the Federal Energy Technology Center (FETC) and the National Petroleum Technology Office (NPTO). Activities of the staff include contract and lab monitoring, development and maintenance of project, budget and procurement plans, and other activities related to program and site support 156

SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

- Field Travel - The decrease provides funds for travel in support of the above stated activities in the attainment of program goals, both on the domestic front and abroad -81
- Field Contract Services - The decrease provides funds for facility operations, maintenance, finance automated office support service, administrative, management and technical support -250

Plant and Capital Equipment

- Construction - The increase provides funding for general plant projects at the Federal Energy Technology Center and the National Petroleum Technology Office 68

Cooperative Research and Development

- Cooperative Research and Development - The decrease provides funding for continued research and UNDEERC and WRI -4

Fossil Energy Environmental Restoration

- CERCLA Remedial Actions - The decrease provides funding for the continued cleanup of the Rock Springs and Hoe Creek sites; continuation of the Hannah site revegetation; soil and groundwater cleanup at the FETC-PGH former liquefaction site; and assessment/site investigations of inactive projects -594
- RCRA Remedial Actions - The decrease provides for continued on-site remediation activities -2,500
- Other ES&H Actions - The increase provides for continuing recurring ES&H activities at the FETC sites 1,159

Fuels Program

- Fuels Program - The funding level remains at the FY 1998 level of funding 0

SUMMARY OF CHANGES - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

Advanced Metallurgical Processes

- Advanced Metallurgical Processes - The increase continues research on extending the service life on materials while addressing ways to improve environmental impact of hazardous materials paths and processes

35

FY 1999 OMB Budget Request

\$383,408

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

ADVANCED CLEAN FUELS RESEARCH

I. **Mission Supporting Goals and Objectives:**

The Energy Policy Act (EPACT) of 1992 Title XIII, Subtitle A, Section 1301 authorizes programs research, development, demonstration and commercialization of coal based technologies. Title XIII, Subtitle A, Sections 1305 and 1312 of this act also authorizes separate programs for research, development, demonstration and commercial application of improved technologies to refine coal to a variety of fuel and non-fuel products and to convert coal into oil substitutes. In compliance with these provisions of EPACT and consistent with these goals, the Advanced Fuels Research Program consists of five related activities: Coal Preparation, Direct Liquefaction, Indirect Liquefaction, Advanced Research and Environmental Technology, and Systems for Coproducts.

Coal Preparation (Solid Fuels and Feedstock) - The program's funding is directed toward the development of advanced solid fuels and feedstocks technologies to: (1) develop and verify innovative processing, handling, and transportation technologies that will improve the overall efficiency, economics, and environmental performance of energy utilization systems, (2) reduce environmental impacts associated with the generation of greenhouse gases and hazardous air pollutants from utilization of coal, (3) permit greater recoveries of the useful energy of the mined coal, (4) encourage the recovery of previously lost carbon raw materials from waste (culm piles/ponds), and (5) support the development of technology for the production of premium carbon and industrial products. These technologies will yield a wide range of products that are economically competitive and which meet the specifications for and can be used with less environmental impact than other competing fuels and products.

Coal Liquefaction (Coal Derived Transportation Fuels) - The need for liquid fuels is forecast to be a critical element of this nation's energy future in the 21st century. The Coal Derived Transportation Fuels program supports basic and applied research to develop the scientific and engineering knowledge base with which industry can bring economically competitive and environmentally acceptable advanced technology for the manufacture of liquid fuels from coal into the marketplace when needed. Coal Derived Transportation Fuels produce a complete spectrum of liquid fuels which could be utilized in the existing infrastructure.

I. **Mission Supporting Goals and Objectives:** ADVANCED CLEAN FUELS RESEARCH (Cont'd)

The Department's efforts are focused upon the two different and distinct approaches to producing liquid fuels from coal, direct liquefaction and indirect liquefaction. Direct liquefaction processes convert the complex organic chemical structures found in coal directly to liquid components by hydrogenation. Indirect liquefaction involves coal gasification to produce synthesis gas (a mixture of carbon monoxide and hydrogen) followed by the catalytic conversion of the synthesis gas to liquids. Each of these approaches has unique characteristics that make it a candidate for commercial development under certain market conditions. The Coal Derived Transportation Fuels program is being structured to include entrance technology which would be integrated with existing facilities; thereby decreasing the cost of coal-derived liquid products. This program being coordinated with the Office of Transportation Technologies (EE) and the Office of Oil and Gas, for the development of premium fuels and new diesel engine development for use in sports/utility vehicles and light trucks which will achieve significantly greater efficiency with substantially lower emissions. The FY 1999 budget request supports the continued development of Coal Derived Transportation Fuels technologies at the laboratory and bench scale and support studies and engineering evaluations are needed to guide the research and development efforts in support of the objective of providing coal-derived liquid fuels at costs competitive with crude oil around \$19-25 per barrel within the next decade.

Advanced Research and Environmental Technology (Advanced Fuels Research) - The thrust of this subprogram includes elements that respond to the "Grand Challenges" which coal fuel technologies must overcome to continue coal use in sustainable manner during the next century. These elements include research and early development of improved and innovative concepts for producing transportation fuels, chemicals and carbon products with high efficiency, improved environmental performance, and reduced carbon dioxide production.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Coal Preparation	\$5,025	\$5,064	\$4,847	\$-217	-4%
Direct Liquefaction	4,955	5,816	2,800	-3,016	-52%
Indirect Liquefaction	4,151	4,223	5,500	1,277	30%
Advanced Research and Environmental Technology	<u>1,700</u>	<u>741</u>	<u>1,781</u>	<u>1,040</u>	<u>140%</u>
Total, Advanced Clean Fuels Research	<u>\$15,831</u>	<u>\$15,844</u>	<u>\$14,928</u>	<u>\$-916</u>	<u>-6%</u>

II. B. **Laboratory and Facility Funding Schedule:** ADVANCED CLEAN FUELS RESEARCH

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Federal Energy Technology Center	\$4,499	\$4,898	\$3,305	\$-1,593	-25%
Sandia National Laboratories	1,000	891	450	-441	-49%
Argonne National Lab (East)	250	75	0	-75	0%
All Other	<u>10,082</u>	<u>9,980</u>	<u>11,173</u>	<u>1,193</u>	<u>12%</u>
Total, Advanced Clean Fuels Research	<u>\$15,831</u>	<u>\$15,844</u>	<u>\$14,928</u>	<u>\$-916</u>	<u>-1%</u>

III. **Performance Summary:** ADVANCED CLEAN FUELS RESEARCH

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Coal Preparation	<p>Premium Fuels/Air Toxics:</p> <p>Complete research on advanced physical coal cleaning methods to produce premium coal fuels very low in ash, sulfur and air toxic precursors. Complete advanced selective agglomeration process demonstration unit testing, and prepare final report. Continue research on advanced physical, and biochemical coal cleaning techniques to remove air toxic precursors. (\$1,680) (AMAX, VPI, CQ, Inc, Little Bear)</p>	<p>Premium Fuels/Air Toxics:</p> <p>Continue research on advanced coal cleaning to remove air toxic precursors focusing on mercury removal. (\$200) (TBD)</p>	<p>Air Toxics:</p> <p>Continue research on advanced coal cleaning to remove air toxic precursors including mercury removal. (\$500) Initiate research for very high removal of air toxic precursors at significantly lower cost than achievable with current technologies. (\$750) (Total \$1,250) (TBD)</p>

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Coal Preparation (Cont'd)	<p>High Efficiency Processors:</p> <p>Continue high efficiency process development efforts at outside facilities. (\$600) (CI, VPI, ARC)</p> <p>In-House:</p> <p>Conduct in-house bench-scale research on advanced physical and chemical coal cleaning concepts. (\$2,340) (PETC, B&R)</p>	<p>High Efficiency Processors:</p> <p>Continue high efficiency process development efforts at outside facilities (\$592). Conduct advanced carbon recovery research (\$221). (Total \$813) (CI, VPI, ARC, TBD)</p> <p>In-House:</p> <p>Conduct in-house bench-scale research on advanced physical and chemical coal cleaning and ancillary operations concepts. (\$2,330) (PETC, B&R)</p>	<p>High Efficiency Processors:</p> <p>Continue high efficiency process research to further develop the technology base for efficient beneficiation, handling and marketing of coal fines. Initiate research at outside facilities for advanced technologies for enhanced carbon recovery from coal. (\$745) (TBD)</p> <p>In-House:</p> <p>Conduct in-house laboratory and bench-scale research on solid fuels technologies to enhance utilization of coal waste products, improve coal fines processing, manufacture of carbon products, and prepare coal/biomass/waste feedstocks to lower emissions of greenhouse gases. (\$1,605) (FETC, B&R)</p>

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Coal Preparation (Cont'd)	Initiate advanced fine coal dewatering research to enable the commercial deployment of advanced coal cleaning systems previously developed (\$200). Research on solid fuels for advanced combustion systems. (\$154) (Total \$354) (TBD)	Initiate advanced fine coal dewatering research and development to enable the commercial deployment of advanced coal cleaning systems previously developed (\$620). Initiate activities and PRDA for advanced technologies for carbon recovery, preparation of coal/biomass/ waste feeds, production of tailored feedstocks for transportation fuels and premium carbon products (\$1,000) (Total \$1,620) (TBD)	Initiate research at outside facilities for advanced technologies for the preparation of coal/biomass/waste feeds, for fine coal dewatering, and for the production of tailored feedstocks for transportation fuels and premium carbon products. (\$1,199) (TBD)
	No activity. (\$0)	Support a Utility Sector Consortium for coal utilization research. (\$50) (UCIG)	No activity. (\$0)
	Fund technical and program management support. (\$51)	Fund technical and program management support. (\$51)	Fund technical and program management support. (\$48)
	\$5,025	\$5,064	\$4,847

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Direct Liquefaction	Continue, at reduced level of effort, limited industrial bench scale research on advanced liquefaction processes. (\$1,200) (CAER)	Continue, at reduced level of effort, limited industrial bench scale research on advanced liquefaction processes. (\$1,366) (CAER, HTI)	Continue limited industrial bench scale research on advanced two-stage liquefaction including support of the China initiative. (\$1,000) (HTI)
	Continue exploratory and bench continuous studies in coprocessing research. (\$13) (HTI)	Continue exploratory and bench continuous studies in coprocessing research. (\$400) (HTI)	Continue exploratory and bench scale continuous studies in coprocessing research. (\$400) (HTI)
	Maintain laboratory, exploratory research on innovative process concepts. (\$2,492) (FETC, SNL, Burns & Roe, UNDEERC, Consol)	Maintain laboratory, exploratory research on innovative process concepts. (\$2,092) (FETC, ANL, SNL, Burns & Roe, Consol)	Study of novel concepts for achieving improvements in two-stage liquefaction to achieve greater efficiency and lower cost. (\$650) (FETC, SNL)
	Continue supporting engineering and economic guidance at Mitretek (\$180). Continue process stream characterization. (\$250) (Total \$430) (Mitretek, Consol)	Continue supporting engineering and economic guidance at Mitretek (\$200). Continue process stream characterization. (\$250) Initiate Pioneer plant feasibility study (\$100) (Total \$550) (Mitretek, Consol, TBD)	Continue supporting engineering economic and market studies for liquefaction technology. (\$150) (Mitretek)

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Direct Liquefaction (Cont'd)	Continue end use and emissions study for coal derived transportation fuels. (\$470) (Bechtel)	Continue characterization and end use study for coal derived transportation fuels. (\$455) (Consol, WVU, TBD)	No activity. (\$0)
	Continue waste/coal coprocessing study. (\$300) (HTI)	Continue waste/coal coprocessing study. (\$895) (HTI)	Continue waste/coal coprocessing bench-scale studies. (\$572) (HTI)
	Fund technical and program management support. (\$50)	Fund technical and program management support. (\$58)	Fund technical and program management support. (\$28)
	\$4,955	\$5,816	\$2,800
Indirect Liquefaction	No activity. (\$0)	No activity. (\$0)	Conduct LaPorte alternative fuels facility operation for production of Fischer-Tropsch diesel and DME for engine testing in cooperation with the Office of Energy Efficiency and the Office of Oil and Gas. (\$300) (APCI)

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Indirect Liquefaction (Cont'd)	Continue FETC in-house research on Fischer-Tropsch (F-T) chemistry (\$450). Continue bench scale F-T iron and cobalt catalyst development (\$550). Continue slurry F-T reactor design data base (\$664). (Total \$1,664) (FETC, Sandia, KY Research Foundation, Air Products, TBD)	Continue FETC in-house research on Fischer-Tropsch (F-T) chemistry (\$405). Continue bench scale F-T iron and cobalt catalyst development (\$704). Continue slurry F-T reactor design data base (\$771). (Total \$1,880) (FETC, Sandia, KY Research Foundation, Air Products, TBD)	Continue FETC in-house research on Fischer-Tropsch (F-T) chemistry (\$750). Continue bench scale F-T iron catalyst development for coproduction of electricity, fuels and chemicals (\$900). Continue slurry reactor design data base (\$1,100). (Total \$2,750) (FETC, Sandia, Air Products, TBD)
	Continue bench scale oxygenate catalyst development. (\$2,184) (Air Products, RTI)	Continue bench scale oxygenate and chemicals catalyst and process development (\$1,740) (Air Products, RTI)	Continue bench scale DME diesel derivative and chemicals catalyst and process development. (\$1,100) (Air Products)
	Continue research guidance study at Mitretek (\$150). FETC technical support (\$110). (Total \$260) (Mitretek, Burns & Roe)	Continue research guidance study at Mitretek (\$169). FETC technical support (\$100). Initiate feasibility study conceptual design for pioneer F-T Plant (\$100) (Total \$369) (Mitretek, Burns & Roe, TBD)	Continue research guidance study at Mitretek (\$150). Continue feasibility study conceptual design for pioneer F-T Plant with industrial consortium (\$1,145). (Total \$1,295) (Mitretek, TBD)
	Conclude syngas production integration study with prior year funds. (\$0) (TBD)	Initiate development of the air separation membrane (\$191) (TBD)	No activity. (\$0)

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Indirect Liquefaction (Cont'd)	Fund technical and program management support. (\$43)	Fund technical and program management support. (\$43)	Fund technical and program management support. (\$55)
	\$4,151	\$4,223	\$5,500
Advanced Research and Environmental Technology	Continue research on coprocessing of coal with waste materials. (\$126) (FETC, TBD)	Continue research on coprocessing of coal with waste materials. (\$282) (FETC)	Conduct research on coprocessing of coal, resid and waste materials, biomass which could lead to clean transportation fuels with reduced CO ₂ byproduct production (\$300) (FETC)
	Continue limited research on improved methods for characterizing coal-derived liquids (\$192). Continue support of the Consortium for Fossil Fuel Liquefaction Science (\$944). (Total \$1,136) (FETC, Univ. of KY)	Continue limited research on improved methods for characterizing coal-derived liquids. (\$281) (FETC)	Conduct research on improved and innovative methods for preparing coal-derived liquids by the Consortium for Fossil Fuel Liquefaction Science (\$300). Conduct laboratory activity to develop an extract concept for producing carbon materials such as carbon electrodes (\$100). Initiate exploratory research to improve understanding of the techniques to produce carbon fiber materials (\$250). (Total \$650) (FETC, Univ of KY, WVU)

III. **Performance Summary**: ADVANCED CLEAN FUELS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Research and Environmental Technology (Cont'd)	Continue, at a reduced level, projects on advanced catalysts for coal liquefaction, including research on fine particle size catalysts. Continue catalyst testing activities at SNL. (\$421) (SNL, TBD)	Continue, at a reduced level, projects on advanced catalysts for coal liquefaction, including research on fine particle size catalysts. Continue catalyst testing activities at SNL. (\$171) (SNL)	No activity. (\$0)
	No activity. (\$0)	No activity. (\$0)	Initiate PRDA to conduct laboratory research on improved and innovative concepts for producing liquid transportation fuels and chemicals which will be highly efficient, achieve improved environmental performance with reduce CO ₂ byproduct production. (\$813) (TBD)
	Fund technical and program management support. (\$17)	Fund technical and program management support. (\$7)	Fund technical and program management support. (\$18)
	\$1,700	\$741	\$1,781
Advanced Clean Fuels Research, Total	\$15,831	\$15,844	\$14,928

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

ADVANCED CLEAN/EFFICIENT POWER SYSTEMS

I. Mission Supporting Goals and Objectives:

This program supports several advanced power systems based on coal combustion or coal gasification and advanced environmental control technologies to further the national goal of maintaining the use of clean coal in the mix of energy resources to meet future energy needs while addressing climate change concerns. The program goal is to develop progressively higher efficiency power systems with 10-20% lower cost of electricity, that significantly lowers carbon emissions, and ultimately near zero levels of pollutants, while eventually evolving into a Vision 21 fleet of new power and energy plants. Development of these advanced power systems will enable the coal-fired plants of the future to produce low-cost electricity with minimal environmental impact and provide for cost-effective emissions control systems for both existing and new power plants, at high efficiency and reliability levels. Four power systems along with supporting advanced research and environmental technology are being developed with funding under this program to accelerate commercialization of these technologies. They are:

Advanced Pulverized Coal-Fired Powerplants - These systems take pulverized coal combustion, the most widely accepted technology for coal-fired generation at the present time, a major step forward by redesigning the process to gain major performance improvements. The Low-Emission Boiler System (LEBS) integrates methods of emission control with a super critical steam cycle at the outset of design. This results in a powerplants with very low emissions and significantly higher efficiency than a conventional pulverized coal powerplant. Advanced Pulverized Coal-Fired systems should achieve early market entry enhancing the export potential for these technologies. Target performances are system efficiencies of 42% and SO₂ and NO_x emissions less than 1/6 the Environmental Protection Agency's New Source Performance Standards (NSPS). Three contractors completed Phases II and III of LEBS in FY 1997. DB Riley was selected to continue Phase IV, which will conclude with the construction and operation of a proof-of-concept (POC) facility in 2001.

Indirect Fired Cycle (IFC) - IFC systems are coal-fired combined cycle systems that produce energy cleanly and efficiently. The IFC program focused on High Performance Power Systems (HIPPS) incorporates a new high temperature advanced furnace which

I. **Mission Supporting Goals and Objectives:** ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

integrates the combustion, heat transfer and emission control processes. The first generation HIPPS will have system efficiencies around 47% and emission levels less than 1/10 NSPS. More advanced systems will be capable of achieving system efficiencies greater than 47%. System efficiencies of 50% and greater will dramatically reduce carbon dioxide emissions levels and help mitigate global climate change. The very low pollutant emissions will enable the utility sector to better respond to projected growth in electricity demand while complying with the SO₂ emissions cap set by the Clean Air Act Amendments of 1990. In FY 1999, the major thrust will be a continuation of Phase II engineering development of concepts selected in FY 1995.

High Efficiency-Integrated Gasification Combined Cycle - The objective of the IGCC program is to foster the development and commercialization of gasification-based processes for converting carbonaceous feedstocks to electricity and steam, fuels, chemicals, or hydrogen. Compared with today's technologies, IGCC offers the potential for significant increases in thermal efficiency as well as significant reductions in capital costs and emissions of hazardous air pollutants. In addition, IGCC is the only advanced power generation technology capable of coproducing electricity and other valuable products. In order to achieve the full potential of IGCC, significant advancements must be made to reduce the cost of these advanced gasification systems while targeting efficiencies of at least 52% and reducing environmental emissions well below 1/10 NSPS. In FY 1999, the thrust of the program will focus on the optimization of IGCC for power generation; the control of potential air toxics, hazardous air pollutants, and carbon dioxide; and the development and demonstration of technologies for reducing greenhouse gas emissions and develop Vision 21 concepts. The IGCC program will be coordinated with other Departmental elements focusing on the production of fuels and chemicals from synthesis gas and the sequestration and utilization of carbon dioxide. The successful accomplishment of these activities will enhance the commercialization prospects of advanced IGCC technologies for the production of electricity for use by utilities, independent power producers, and other industrial stakeholders, as well as provide technologies for the coproduction of power and other valuable commodity products.

High Efficiency Pressurized Fluidized Bed (PFB) - PFB systems have several advantages including high combustion and heat transfer efficiency inherent to fluid beds; sulfur dioxide removal integral to the combustion process through introduction of sorbent into the fluid bed; and low NO_x emissions as a consequence of low combustion temperatures. Combustion efficiency, SO₂ and NO_x control are all enhanced by application of pressure. The PFB program is directed toward developing systems with efficiencies approaching 45% with SO₂ and NO_x levels of 1/5 NSPS and conducting research to further improve the efficiency of the PFB systems over 50% with SO₂ and NO_x levels of 1/10 NSPS. The thrust of the research is in hot gas particulate filtration, critical to advanced PFBC systems, and improvements in the subsystems and the interfaces thereof to enhance system efficiency and reduce cost and pollutant emissions

I. **Mission Supporting Goals and Objectives:** ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

necessary for market entry. In FY 1999, major emphasis will be on simple cycle operation and first generation operation of the Advanced Pressurized Fluidized Bed pilot scale project at the Wilsonville Power System Development Facility.

Advanced Research and Environmental Technology - The thrusts of this subprogram involve supporting crosscutting activities that are essential to the development of advanced clean/efficient power systems and highly efficient, cost-effective environmental control technologies for both retrofit and new powerplants. Results of this advanced research are used by those who develop, design, manufacture and operate both existing and advanced systems across the entire spectrum of coal utilization technologies not only to improve efficiencies, but also to improve environmental performance. Environmental Technology crosscutting efforts address the cost-effective removal of pollutant causing contaminants from fossil fueled systems. It focuses on the development of super clean emissions control technology (greater than 95% reduction) for SO₂, NO_x, air toxics and particulates to address the energy and environmental demands of the post-2000 timeframe; reduction of CO₂ emissions from coal-based energy systems; technical, economic and environmental assessments of sequestration of greenhouse gas emissions; development of emission controls with saleable byproducts to minimize or eliminate liquid/solid wastes from coal-fired powerplants; sampling and characterization of advanced power system byproducts; and test and evaluation of disposal and utilization systems for coal utilization byproducts. A major thrust of this program area is the development of technology to comply with the requirements of the Clean Air Act Amendments (CAAA) of 1990 and new or pending regulations. The FY 1999 budget request emphasizes development of retrofit NO_x control technologies for compliance with CAAA Title I and Title IV, Phase II regulations and new PM_{2.5} and ozone National Ambient Air Quality Standards for essentially all existing coal-based power plants.

. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Advanced Pulverized Coal-Fired Powerplants	\$9,250	\$16,112	\$15,000	\$-1,112	-7%
Indirect Fired Cycle	9,772	4,927	6,000	1,073	22%
High Efficiency - Integrated Gasification Combined Cycle	22,037	22,342	33,500	11,158	50%
High Efficiency - Pressurized Fluidized Bed	17,461	17,875	14,638	-3,237	-18%

A. **Funding Schedule:** ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Advanced Research and Environmental Technology	<u>9,239</u>	<u>12,734</u>	<u>22,400</u>	<u>9,666</u>	<u>76%</u>
Total, Advanced Clean/Efficient Power Systems	<u>\$67,759</u>	<u>\$73,990</u>	<u>\$91,538</u>	<u>\$17,548</u>	<u>24%</u>

II. B. **Laboratory and Facility Funding Schedule:** ADVANCED CLEAN/EFFICIENT POWER SYSTEMS

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Oak Ridge National Lab	\$49	\$0	\$50	\$50	0%
Argonne National Lab (East)	250	0	0	0	0%
Lawrence Berkeley Lab	324	0	0	0	0%
Federal Energy Technology Center	14,403	14,004	12,530	-1474	-11%
All Other	<u>52,733</u>	<u>59,986</u>	<u>78,958</u>	<u>18,972</u>	<u>32%</u>
Total, Advanced Clean/Efficient Power Systems	<u>\$67,759</u>	<u>\$73,990</u>	<u>\$91,538</u>	<u>\$17,548</u>	<u>24%</u>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Pulverized Coal- Fired Powerplants	<p>Complete Phase II. Initiate and complete Phase III engineering design of site-specific proof-of-concept (POC) facility. Downselect and initiate Phase IV detail design and construction of POC facility. Goal is 42% efficiency, SO₂ and NO_x emissions less than 1/6 NSPS and minimal solid waste. Cost sharing of 25% required for Phase III, 50% for Phase IV. (\$9,070). Implement customer service activities (\$85). (Total \$9,155) (TBD)</p> <p>Fund technical and program management support. (\$95)</p> <p>\$9,250</p>	<p>Begin Phase IV which includes the construction and operation of a proof-of-concept facility. Goal is 42% efficiency, SO₂ and NO_x emissions less than 1/6 NSPS and minimal solid waste. Cost sharing of 50% required for Phase IV. (\$15,236). Implement customer service activities (\$85). Co-firing of coal and hospital wastes (\$630) (Total \$15,951) (Donlee Technologies, TBD)</p> <p>Fund technical and program management support. (\$161)</p> <p>\$16,112</p>	<p>Continue Phase IV which includes the construction and operation of a proof-of-concept facility. Goal is 42% efficiency, SO₂ and NO_x emission less than 1/6 of NSPS and minimal solid waste. Cost sharing of 50% required in Phase IV. (\$14,765) Implement customer service activities (\$85) (Total \$14,850) (DB Riley, TBD)</p> <p>Fund technical and program management support. (\$150)</p> <p>\$15,000</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Indirect Fired Cycle	<p>Continue HIPPS Phase II engineering development and testing with a goal of 47% efficiency, pollutant emissions 1/10 NSPS, and generation of usable by-products in lieu of wastes. Cost-sharing minimum of 25% required for Phase II. (\$7,941) (Foster Wheeler, UTRC)</p> <p>Continue FETC in-house research on combustion mechanisms and pollutant formation/suppression/removal in highly turbulent flows for application to HIPPS technology (\$1,456). Fund project management support (\$225) and customer service (\$50). (Total \$1,731) (FETC, TBD)</p> <p>Fund technical and program management support. (\$100)</p>	<p>Continue HIPPS Phase II engineering development and testing of components and sub-systems. Goal is 47% efficiency, SO₂ and NO_x emissions less than 1/10 NSPS, and generation of usable by-products in lieu of wastes. Cost-sharing minimum of 25% required for Phase II. (\$3,502) (Foster Wheeler, UTRC)</p> <p>Continue FETC in-house research on combustion mechanisms and pollutant formation/suppression/removal in highly turbulent flows for application to HIPPS technology (\$950). Fund project management support (\$376) and customer service (\$50). (Total \$1,376) (FETC, TBD)</p> <p>Fund technical and program management support. (\$49)</p>	<p>Refocus HIPPS development on those components and subsystems that are part of the Vision 21 plant. (\$4,414) (Foster-Wheeler, UTRC)</p> <p>Continue FETC in-house research on combustion mechanisms and pollutant formation/suppression/removal in highly turbulent flows for application to HIPPS technology (\$1,100). Project management (\$376). Customer service (\$50). (Total \$1,526) (FETC, TBD)</p> <p>Fund technical and program management support. (\$60)</p>
	\$9,772	\$4,927	\$6,000

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Integrated Gasification Combined Cycle	Initiate testing of the transport reactor train and the associated hot gas particulate control devices in an IGCC made at the Wilsonville Power Systems Development Facility (20% cost share). (\$9,676) (SCS)	Conduct long-term testing the transport reactor train and the associated hot gas particulate control devices at the Wilsonville Power Systems Development Facility (20% cost share). (\$10,000) (SCS)	Continue development of the transport-bed gasifier and associated hot gas particulate control devices at the Wilsonville Power Systems Development Facility (PSDF). Begin design activities for the construction of a fluid-bed desulfurization reactor (20% cost share). (\$9,610) (SCS)
	Complete construction and shakedown of the novel fluid-bed/transport-regime PDU desulfurizer at FETC and initiate testing using the syngas generator gas supply. (\$4,525) (FETC/M. W. Kellog)	Continue PDU operation of the novel fluid-bed/transport-regime desulfurizer at FETC to evaluate desulfurization concepts and sorbents. (\$4,417) (FETC/M. W. Kellog)	Continue PDU operation of FETC's novel fluid-bed/transport reactor to evaluate desulfurization process concepts and sorbents. (\$3,100) (FETC, TBD)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Integrated Gasification Combined Cycle (Cont'd)	Complete work on desulfurization sorbents for moving-bed applications. Initiate in-house R&D for advanced sorbents for fluidized-bed transport desulfurizers. Continue R&D and testing of novel and advanced sulfur sorbents and systems. Explore new R&D concepts for direct sulfur recovery. Initiate testing of promising hot gas cleanup materials, components, or subsystems in existing or planned pilot or demonstration facilities through slipstream/coupon testing. (\$3,689) (GE, FETC, RTI, TBD)	Continue R&D and testing of novel and advanced sulfur sorbents and systems. Continue in-house testing for advanced sorbent for fluid bed/transport desulfurizers. Complete R&D on advanced direct sulfur recovery concepts. Validate performance of promising hot gas cleanup materials, components, or subsystems in existing or planned pilot or demonstration facilities through slipstream/coupon testing. (\$4,181) (GE, FETC, RTI, TBD)	Continue R&D and testing to develop high capacity, regenerable, attrition-resistant sorbents for use in fluid-bed/transport desulfurization reactors. Initiate project to test the direct sulfur recovery process at the Wilsonville PSDF on coal-derived synthesis gas. Continue development of novel single-step processes for removal of sulfur and ammonia. (\$2,900) (FETC, RTI, GE, TBD)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Integrated Gasification Combined Cycle (Cont'd)	<p>Pursue R&D on NO_x reduction for IGCC systems as follow-on to H₂S/NH₃ work. Continue R&D for characterization and control of alkali and HAPS/trace species in IGCC streams. Continue characterization testing on filter material. (\$675) (UNDEERC, TBD)</p> <p>Complete integrated fixed-bed gasifier/hot gas cleanup IGCC PDU tests in a high temperature moving-bed desulfurizer. Continue advanced sulfur sorbent systems development (\$3,022). Implement customer service activities (\$225). (Total \$3,247) (GE, TBD)</p>	<p>Test identified successful concepts for NO_x reduction for IGCC systems. Investigate advanced concepts for cost effective CO₂ recovery. Continue R&D for characterization and control of alkali and HAPS/trace species in IGCC streams. Complete characterization testing on filter material. (\$1,896) (UNDEERC, TBD)</p> <p>Close-out and dispose of GE integrated fixed-bed gasifier/hot gas cleanup facility. Continue advanced sulfur sorbent systems development. Implement customer service activities. (\$1,625) (GE, HQ)</p>	<p>Conduct IGCC design optimization study to obtain firm cost, schedule, and performance data. Continue R&D on the control of alkali and HAP's/trace species. Investigate CO₂ recovery and utilization technologies. Implement customer service activities. (\$3,080) (UNDEERC, FETC, TBD)</p> <p>Conduct innovative approaches for improving plant efficiencies for power and fuels production, thereby reducing greenhouse gas emissions. Conduct work on the development and integration of advanced air separation technologies with gasification and advanced gas turbines (\$4,175).</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Integrated Gasification Combined Cycle (Cont'd)			Accelerate the development of high temperature hydrogen membrane separation technologies for integrated IGCC/fuel cell applications (\$1,500). Develop advanced gas cleanup technologies for meeting more stringent gas quality requirements for fuel cell integration (\$2,300). Conduct experimental investigations on biomass gasification and perform system analyses for integration of IGCC/fuel cell/advanced turbines/co-production applications in the pulp and paper industry (\$3,500). Perform experimental testing of cofiring of biomass and municipal wastes and perform relevant system integration studies. Conduct feasibility studies for cofiring/coproduction applications (\$3,000). (Total \$14,475) (TBD, ANL)
	Fund technical and program management support. (\$225)	Fund technical and program management support. (\$223)	Fund technical and program management support. (\$335)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
High Efficiency - Integrated Gasification Combined Cycle (Cont'd)	\$22,037	\$22,342	\$33,500
High Efficiency - Pressurized Fluidized Bed	Continue evaluation of the newly selected materials, devices and systems developed in previous work toward refining and validating design of a second generation hot gas particulate filtration, candle filter system capable of meeting basic performance requirements for CCT demonstrations. (\$1,412) (SRI, EERC)	Continue evaluating new materials, devices and systems developed in previous work for the purpose of selecting the most promising materials to be tested with the second generation advanced cycle PFBC high efficiency system at the Wilsonville PSDF capable of meeting basic performance requirements for CCT demonstrations. (\$1,500) (TBD)	Continue evaluation of previously selected and developed HGCU barrier filter materials, devices and systems toward refining and validating designs. Continue to focus on development and testing newly selected materials for applicability to HGCU barrier filtration and evaluation of new filter configurations and system designs for PFBC applications with potential to significantly enhance performance and reduce cost relative to first and second generation systems. (\$2,762)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Pressurized Fluidized Bed (Cont'd)	Continue testing of newly selected materials for applicability to hot gas particulate filtration and evaluation of new filter configuration and system designs with potential to significantly enhance performance and reduce cost relative to first generation systems. (\$1,425) (Westinghouse, SRI, TBD)	Continue testing new materials for applicability to hot gas particulate filtration and evaluation of new filter configuration and system designs with potential to significantly enhance performance and reduce cost relative to first generation PFBC systems. (\$2,200) (TBD)	Included in activity above.
	Continue R&D at FETC on PFB dynamics, advanced concepts, combustion characterization and fundamental research to reduce the risks associated with commercialization of this technology. (\$1,950)	Continue R&D at FETC on PFB dynamics, advanced concepts, combustion characterization and fundamental research to reduce the risks associated with commercialization of this technology. (\$2,746)	Continue R&D at FETC (Morgantown) on PFB dynamics, advanced concepts, combustion characterization and fundamental research to reduce the out year risks associated with commercialization of this technology. FETC's emphasis in the near term will focus primarily in the HGCU and GT technology areas followed by efforts to attain the year 2010 goals. (\$2,746)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Pressurized Fluidized Bed (Cont'd)	<p>Implement customer service activities. (\$250) (HQ)</p> <p>Continue efforts aimed at improvements in environmental performance and efficiency with emphasis on assessing HAPS emissions and control strategies. (\$800) (FETC)</p>	<p>Continue customer service activities. (\$250)</p> <p>Continue efforts aimed at improvements in environmental performance and efficiency on first and second generation systems. (\$1,000) (FETC)</p>	<p>Continue customer education activities, via future site specific repowering studies. Long term efforts would be to promote repowering of an actual electricity producer's site at minimum cost to the government. (\$154)</p> <p>Continue effort aimed at improvements in environmental performance and efficiency with emphasis on assessing emissions with focus on HAPS, control strategies and GT development. Near term spotlight is on HGCU, GT, and coal/feed systems development to meet the year 2005 goals. Cycle improvements through the introduction of other technologies like the Kalina Cycle and super critical steam cycles will be pursued to achieve the year 2010 goals. (\$700) (FETC)</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
High Efficiency - Pressurized Fluidized Bed (Cont'd)	Complete construction of Advanced PFB pilot scale project at Wilsonville and initiate shakedown testing of a PFB pilot scale 2nd generation system capable of achieving 43-45% efficiency with cost-sharing of 20% by industry. (\$11,445) (Southern Co. Services)	Begin operation of Advanced PFB pilot scale project at Wilsonville and initiate shakedown testing of a PFB pilot scale 2nd generation system capable of achieving 43-45% efficiency with cost-sharing of 20% by industry. (\$10,000) (Southern Co. Services)	Continue operation of the APFBC pilot scale project at Wilsonville. (\$8,130). (Southern Co. Services, TBD)
	Fund technical and program management support. (\$179)	Fund technical and program management support. (\$179)	Fund technical and program management support (\$146).
	\$17,461	\$17,875	\$14,638
Advanced Research and Environmental Technology	Advanced Research - Combustion Processes	Advanced Research - Combustion Processes	Advanced Research - Combustion Processes
	Close out of prior year contracts (\$12)	No activity. (\$0)	No activity. (\$0)

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research and Environmental Technology (Cont'd)	<p>Environmental Technologies</p> <p>Super Clean Systems:</p> <p>Complete super clean modeling. Continue contracts awarded from the FY 1995 Mega PRDA. Continue reduced level of effort studies at EPRI's HSTC facility toward modification of existing processes to improve performance. Cost-sharing 5% gov't, 95% EPRI. (\$2,072) (EER, CMU, Praxis, B&W, EPRI, Radian, ADL)</p>	<p>Environmental Technologies</p> <p>Super Clean Systems:</p> <p>Downselect ongoing NO_x control contracts and initiate Phase 2. (\$1,400) (EPRI, TBD)</p>	<p>Environmental Technologies</p> <p>Super Clean Systems:</p> <p>Continue ongoing NO_x control projects. (\$1,465) (TBD)</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research and Environmental Technology (Cont'd)	<p>Fine Particulate Control/Air Toxics</p> <p>Continue evaluation and characterization of toxic emissions from powerplants sites. Continue air toxics control technology development (sampling devices). Complete support of B&W Air Toxics Facility using prior year funds. Continue air toxics awards from FY 1995 MEGA PRDA. (\$1,513) (Radian, ABB, LSR, ATS, ADA, PSCO, UNDEERC, B&W)</p> <p>Coke Oven Emissions Control:</p> <p>Complete coke oven emission control technology project using prior year funds. (\$0) (TBD)</p>	<p>Fine Particulate Control/Air Toxics</p> <p>Continue to improve measurement characterization techniques for toxic emissions from powerplants sites. Continue air toxics control technology development with downselection of contracts from FY 1995 MEGA PRDA. (\$5,570) (TBD)</p> <p>Coke Oven Emissions Control:</p> <p>No activity. (\$0)</p>	<p>Fine Particulate Control/Air Toxics</p> <p>Continue, at a reduced level, to improve measurement characterization techniques for toxic emissions from powerplants sites; and ongoing projects to optimize mercury control technologies for both cost-effectiveness and efficiency; develop lower-cost retrofit fine particulate control technology to meet pending new standards. (\$4,000) (TBD)</p> <p>Coke Oven Emissions Control:</p> <p>No activity. (\$0)</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research and Environmental Technology (Cont'd)	<p>CO2 Sequestration:</p> <p>Continue efforts to investigate and/or improve the capabilities of technologies to recover, reuse, and/or dispose of CO2 emissions from coal-fired utility boilers; examine the environmental impacts of various CO2 sequestration alternatives; continue participation in the IEA Greenhouse Gas R&D program. (\$1,065) (IEA, TBD)</p>	<p>CO2 Sequestration:</p> <p>Continue efforts to investigate and/or improve the capabilities of technologies to recover, reuse, and/or dispose of CO2 emissions from coal-fired utility boilers; examine the environmental impacts of various CO2 sequestration alternatives; continue participation in the IEA Greenhouse Gas R&D program. Select novel concepts projects to examine feasibility of innovative approaches to greenhouse gas mitigation. (\$1,579) (IEA, MIT, TBD)</p>	<p>CO2 Sequestration:</p> <p>Continue efforts to investigate and/or improve the capabilities of technologies to recover, reuse, and/or store greenhouse gas emissions from coal-based energy systems; examine the technical, economic and environmental impacts of various CO2 sequestration alternatives; continue participation in the IEA Greenhouse Gas R&D program; continue ongoing exploratory research projects initiated in prior years to mitigate greenhouse gas emissions; continue novel concepts projects selected in prior year to obtain required engineering and environmental data. (\$11,890) (IEA, MIT, TBD)</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research and Environmental Technology (Cont'd)	<p>In-House:</p> <p>Continue in-house research and support in the areas of super clean emissions control, air toxics and fine particulate control, and CO2 control. Provide for customer service and business activities. (\$3,050) (FETC, ANL, LBL, BRSC)</p> <p>Continue field monitoring of advanced technology wastes at Clean Coal disposal sites, at surface mine sites and in deep mines for acid drainage abatement using prior year funds, to assure these wastes do not pose a barrier to the deployment of advanced technologies. (\$0) (Radian)</p> <p>Complete laboratory characterization of advanced technology wastes to assess risks and predict environmental fate using prior year funds. (\$0) (TBD)</p>	<p>In-House:</p> <p>Continue in-house research and support in the areas of super clean emissions control, air toxics and fine particulate control, and CO2 control. Provide for customer service and business activities. (\$2,600) (FETC, BRSC)</p> <p>Continue field monitoring of advanced technology byproducts at Clean Coal disposal sites, at surface mine sites and in deep mines for acid drainage abatement to assure these byproducts do not pose a barrier to the deployment of advanced technologies. (\$200) (Radian)</p> <p>No activity. (\$0)</p>	<p>In-House:</p> <p>Continue in-house research and support in the areas of super clean emissions control, air toxics and fine particulate control, and CO2 control. Provide for customer service and business activities. (\$3,063) (FETC, BRSC)</p> <p>Continue environmental monitoring of completed projects involving advanced power generation technology byproducts at disposal and acid mine drainage abatement sites. (\$140) (TBD)</p> <p>No activity. (\$0)</p>

III. **Performance Summary**: ADVANCED CLEAN/EFFICIENT POWER SYSTEMS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research and Environmental Technology (Cont'd)	Continue in-house characterization of wastes and maintenance of waste-related data bases. (\$157) (FETC)	Continue in-house characterization of coal utilization byproducts and maintenance of related data bases. (\$150) (FETC)	Continue in-house characterization of coal utilization byproducts and maintenance of related data bases. (\$108) (FETC)
	Continue waste disposal minimization efforts, with 50% cost-sharing through the utilization of advanced and clean coal technology residues as by products. Continue advanced waste disposal practices demonstrations. (\$1,276) (WVU, SIU)	Continue byproducts disposal minimization efforts, with 50% cost-sharing through the utilization of advanced and clean coal technology residues as by products. Continue advanced byproducts disposal practices demonstrations. (\$1,108) (TBD)	Conduct joint industry/government R&D activities to maximize use of coal utilization combustion byproducts; develop novel approaches to utilize waste from flue gas desulfurization; conduct evaluations of low NO _x burner and multi-fuel combustion byproducts for market specifications; facilitate technology transfer. (\$1,510) (TBD)
	Fund technical and program management support. (\$94)	Fund technical and program management support. (\$127)	Fund technical and program management support. (\$224)
	\$9,239	\$12,734	\$22,400
Advanced Clean/ Efficient Power System Total	\$67,759	\$73,990	\$91,538

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT

I. **Mission Supporting Goals and Objectives:**

The Advanced Research and Technology Development (AR&TD) Program funds two types of activities. The first is a set of crosscutting studies and assessment activities in environmental activities, technical and economic analyses, coal technology export and international program support. The second is a set of crosscutting applied research programs which include coal utilization science, materials and components, instrumentation and diagnostics, bioprocessing of coal and university-based coal research. The second set of programs includes an activity focused upon Historically Black Colleges and Universities (HBCU) and other minority institutions and addresses the full spectrum of fossil utilization research and development, technology transfer, outreach, and private sector partnerships.

In the crosscutting studies and assessments subprograms, the thrusts of international program support, environmental activities, coal technology export, and technical and economic analysis are to complement and enhance all Fossil Energy endeavors by providing both financial and technological leverage. International involvements are limited to those selected areas where it has been determined that the U.S. will benefit at least to the extent it gives on a quid pro quo basis. FE, through these activities, always attempts to encourage the leveraging of research and development funds while protecting U.S. industrial interests and to use them as opportunities to achieve responsible international consensus and opinion on technical business assessment and policy issues.

The crosscutting applied research programs focus upon developing the technology base in the enabling science and technology areas that are critical to the successful development of both superclean, very high efficiency coal-based power systems and coal-based fuel systems. AR&TD seeks a greater understanding of the physical, chemical, biological and thermodynamic barriers to achieving economic, technologic, and environmental goals and to identify ways to overcome those barriers. The program is unique in that it is directed to specific underlying fundamental scientific and engineering problems closely connected to short-term, mid-term and long-range Fossil Energy objectives.

I. **Mission Supporting Goals and Objectives:** ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

The Coal Utilization Science subprogram focuses on research pertinent to all coal utilization systems, with specific attention paid to increasing our knowledge of the principal mechanisms that control coal combustion processes. A new activity in FY 1999 will be grand challenges. This will address issues affecting the utilization of coal, and its primary response is the development of the Vision 21 concept. It will involve novel concepts for CO₂ capture and sequestration, and virtual demonstration plants. High performance advanced materials and equipment are essential to advanced coal technologies. Thus, the thrust of the advanced materials and components subprogram is to develop solutions to materials performance barriers unique to very high temperature, highly corrosive coal combustion and gasification environments. To support the need for process control, research on instrumentation and diagnostics is undertaken in that subprogram. Exploratory research and innovation to maximize the use of coal in environmentally preferable ways is typified by the bioprocessing of coal subprogram. The focus of the biotechnology program is to produce fuels with significantly lower greenhouse gases content than is currently available. The thrust of the university coal research and HBCU education and training subprograms is to support competitively awarded research grants to universities.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
COAL					
Coal Utilization Science	\$3,117	\$3,030	\$5,330	\$2,300	76%
Technology Crosscut					
Coal Technology Export	854	847	845	-2	0%
Bioprocessing of Coal	<u>1,000</u>	<u>985</u>	<u>1,982</u>	<u>997</u>	<u>101%</u>
Subtotal, Technology Crosscut	1,854	1,832	2,827	995	54%
University/National Laboratory Coal Research					
University Coal Research	<u>2,923</u>	<u>2,915</u>	<u>3,847</u>	<u>932</u>	<u>32%</u>
Subtotal, University/National Laboratory Coal Research	<u>2,923</u>	<u>2,915</u>	<u>3,847</u>	<u>932</u>	<u>32%</u>
Subtotal, COAL	7,894	7,777	12,004	4,227	54%

II.A. **Funding Schedule:** ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
CROSSCUTTING					
Materials and Components					
Materials	4,938	5,225	6,225	1,000	19%
Components	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0%</u>
Subtotal, Materials and Components	4,938	5,225	6,225	1,000	19%
Technology Crosscut					
Environmental Activities	2,235	2,219	2,200	-19	-1%
Technical and Economic Analysis	760	775	1,000	225	29%
International Program Support	<u>609</u>	<u>651</u>	<u>1,150</u>	<u>499</u>	<u>77%</u>
Subtotal, Technology Crosscut	3,604	3,645	4,350	705	19%
University/National Laboratory Coal Research					
HBCUs, Education and Training	<u>916</u>	<u>932</u>	<u>1,000</u>	<u>68</u>	<u>7%</u>
Subtotal, University/National Laboratory Coal Research	<u>916</u>	<u>932</u>	<u>1,000</u>	<u>68</u>	<u>7%</u>
Subtotal, CROSSCUTTING	<u>9,458</u>	<u>9,802</u>	<u>11,575</u>	<u>1,773</u>	<u>18%</u>
Total, Advanced Research and Technology Development	<u>\$17,352</u>	<u>\$17,579</u>	<u>\$23,579</u>	<u>\$6,000</u>	<u>34%</u>

II. B. **Laboratory and Facility Funding Schedule:**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Argonne National Lab (East)	\$1,295	\$1,095	\$1,095	\$0	0%
Idaho National Engineering Lab	325	325	325	0	0%
Federal Energy Technology Center	1,586	1,873	2,000	127	7%

II. B. **Laboratory and Facility Funding Schedule:** ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Oak Ridge National Lab	3,959	4,195	4,198	3	0%
Oak Ridge Operations Office	3	3	0	-3	-100%
Pacific Northwest Lab	690	740	740	0	0%
Sandia National Laboratories	350	400	300	-100	-25%
National Renewable Energy Lab	100	0	0	0	0%
All Other	<u>9,044</u>	<u>8,948</u>	<u>14,921</u>	<u>5,973</u>	<u>67%</u>
Total, Advanced Research and Technology Development	<u>\$17,352</u>	<u>\$17,579</u>	<u>\$23,579</u>	<u>\$6,000</u>	<u>34%</u>

III. **Performance Summary:** ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
COAL Coal Utilization Science	Continue applied research and generic studies to collect the physics, chemistry and thermodynamic data needed by the developers, manufacturers and users of advanced coal utilization systems. Research will be continued on fundamental coal combustion processes, evolution of contaminants and hazardous air toxics, dust cake cleaning of high-temperature filters, advanced concepts for cofiring and NOx control, and advanced predictive models required by designers and	Continue applied research and generic studies to collect the physics, chemistry and thermodynamic data needed by the developers, manufacturers and users of advanced coal utilization systems. Research will be continued on fundamental coal combustion processes, evolution of contaminants and hazardous air toxics, dust cake cleaning of high-temperature filters, advanced concepts for cofiring and NOx control, the fundamentals of char reactivity and	Redirect research toward the Grand Challenges of the Virtual Demonstration Plant and CO ₂ capture, sequestration, and CO ₂ offset, in support of the Vision XXI concept of a power and fuels complex. Initiate studies to determine additional data sets necessary to meet the needs of the Vision XXI concept and the Virtual Demonstration. Initiate competitive solicitation to develop critical enabling technologies for advanced power and fuel systems, and new concepts that will

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
COAL Coal Utilization Science (Cont'd)	manufactures of advanced power systems. This work supports Combustion 2000 and other advanced power systems. (\$3,086) (METC, PETC, SNL, B&R, MIT, Comb. Inst., TBD, UNDEERC, AFR, ANL, BNL, Adelphi Univ.)	advanced predictive models required by designers and manufactures of advanced power systems. This work supports Combustion 2000 and other advanced power systems. (\$3,000) (METC, PETC, SNL, B&R, MIT, Comb. Inst., TBD, UNDEERC, AFR, ANL, BNL, Adelphi Univ.)	significantly reduce or eliminate environmental impacts of coal utilization with special focus on greenhouse gases that affect global climate change. Continue research in basic coal combustion processes, evolution of contaminants and hazardous air toxics, fundamental carbon studies, and advanced predictive models. Complete data collection and coding of first generation structurally-based char reactivity model for predicting levels of unburned carbon resulting from low NOx combustion. Discontinue coal slurry combustion work and transfer the technology to the appropriate line program. Conclude study of ash effects on char reactivity and continue laboratory study of low NOx mechanisms. Address CO ₂ issue by preparing phase I biomass cofiring guidelines . (\$5,277) (FETC, SNL, MIT, Brown U, TBD)

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Coal Utilization Science (Cont'd)	Fund technical and program management support. (\$31)	Fund technical and program management support. (\$30)	Fund technical and program management support. (\$53)
	\$3,117	\$3,030	\$5,330
COAL Technology Crosscut Coal Technology Export	Provide programmatic support for coal and technology export programs and promotion initiatives. Assist in trade missions, seminar programs, support international project development preinvestment efforts by providing Coal Technology Programmatic Support. (\$854) (Resource Dynamics, SoBran, TBD)	Support the U.S. efforts with the World Energy Council (WEC). Continue efforts in the Pacific Rim including sharing best practice information with utilities. Continue ongoing projects in the African Region. Develop collaborative R&D projects with Russia and Italy. Implement cooperative activity with India. Continue to regionalize cooperation and energy production in the Black Sea Region and Near East. (\$847) (TBD)	Continue efforts to support deployment of cleaner coal and power generation systems internationally. Pursue opportunities identified by the Houston Conference on the Strategic Value of Clean Fossil Fuel Systems for the international sale of U.S. clean coal technologies and continue efforts to develop collaborative environmental partnerships among major developing nations, U.S. states and local governments, NGO's and industry to support regional efforts to promote the increased use of cleaner power systems. Continue efforts in the Pacific Rim including sharing best practice information with utilities. (\$845) (TBD)
	\$854	\$847	\$845

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Bioprocessing of Coal	Continue research at lower level on bioprocessing of coal. Continue a reduced number of industry/National Lab collaborative projects on applications of biotechnology to coal conversion and utilization, with special emphasis on involvement of small/emerging companies. (\$990) (ORNL, INEL, TBD)	Continue research at lower level on bioprocessing of coal. Continue a reduced number of industry/National Lab collaborative projects on applications of biotechnology to coal conversion and utilization, with special emphasis on involvement of small/emerging companies. (\$975) (ORNL, INEL, TBD)	Develop processes for fuels that have a significantly lower unit content of greenhouse gases (carbon) than currently available fuels to reduce the impact on global climate change. Demonstrate at pilot scale biological conversion of coal synthesis gas to ethanol, and continue research on novel coal bioconversion processes to enhance economics and environmental acceptability of coal. Investigate the use of electrochemically supplied electron carriers in synthesis gas fermentations. Develop biofiltration system for removal of NO _x from combustion gas streams. (\$1,962) (ORNL, INEL, TBD)
	Fund technical and program management support. (\$10)	Fund technical and program management support. (\$10)	Fund technical and program management support. (\$20)
	\$1,000	\$985	\$1,982
COAL Technology Crosscut, Subtotal	\$1,854	\$1,832	\$2,827

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
COAL			
University/National Laboratory Coal Research - University Coal Research	Support approximately 16 new grants at U.S. colleges and universities for research on coal science, coal surface science, reaction chemistry, advanced process concepts, engineering fundamentals and thermodynamics, environmental science and high temperature phenomena. Emphasize high payoff, fundamental research with student involvement. Continue multidisciplinary pilot program of university/industry team collaborative research within current year's solicitation and program through multidisciplinary category with industry collaboration component. (\$2,893) (TBD)	Support approximately 12 colleges and universities to perform research in four focus areas. Collaborative fundamental research will be emphasized by requiring that all grant recipients in a single focus work cooperatively. Also, joint proposals (university/university, university/industry, minority university/majority university) will be encouraged under each focus area to promote multi-disciplinary, cross-cutting approaches. Under an Innovative Concepts subprogram, provide support to an additional 10 colleges and universities to explore the creative application of ideas and techniques developed in other technological areas to those problems facing the coal research community. (\$2,886) (TBD)	Support grants at U.S. universities which emphasize longer-term research that will accelerate technology development and identify breakthrough technologies for the next century, and address scientific and technological issues that are key to achieving FE's strategic objectives. Increase the number of critical key research areas while ensuring the research efforts remain focused to accelerate the identification of solutions for energy and environmental problems associated with global climate change. Collaboration through joint proposals involving university and industry teams will continue. Continue to explore novel approaches and innovative concepts developed in other scientific and technological areas that will assist in developing breakthrough technologies for coal utilization. (\$3,769) (TBD)

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
COAL (Cont'd)	No activity. (\$0)	No activity. (\$0)	Support the undergraduate internship program to allow those junior-level science and engineering majors to experience fundamental research in the areas of environmental science and engineering, and energy, where no graduate course or degrees are offered in their major field of study. (\$40) (TBD)
University/National Laboratory Coal Research - University Coal Research	Fund technical and program management support. (\$40)	Fund technical and program management support. (\$29)	Fund technical and program management support. (\$38)
	\$2,923	\$2,915	\$3,847
COAL, Subtotal	\$7,907	\$7,777	\$12,004

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
CROSSCUTTING Materials	Continue on a reduced level of effort, that will extend completion by as much as five years, the most essential elements of the high temperature structural ceramic composites, alloys and functional materials developments essential to advanced Fossil power systems. These include high temperature intermetallics; coatings; ceramic composite NDE methods, fabrication processes and design methods; high temperature filters, and fuel cell and gas separation membrane materials and fabrication processes. Other development elements will be terminated, concluded or suspended. These include developments such as the catalyst supports, nanocluster materials and powder processes, fundamental iron aluminide studies, carbon fiber molecular sieves, ceramic joining, ceramic heat exchange tube and materials evaluations, austenitic	Continue only the highest priority elements of the high temperature structural ceramic composites, alloys and functional materials developments that are the most essential to the development of more economic, clean and efficient advanced fossil power systems. These include high temperature intermetallic alloys and corrosion resistant coatings; ceramic composite heat exchanger NDE methods, fabrication processes and design methods; high temperature filters; fuel cell and gas separation inorganic membrane/ electrolyte materials and fabrication processes and carbon composite molecular sieves. (\$5,173) (ANL, INEL, PNL, ORNL, ORO)	Continue those essential activities of the high temperature structural ceramic composites, alloys, and functional materials developments that are enabling elements for the development of economical, high efficiency, and environmentally clean fossil energy power systems. These include the high- and very high-temperature intermetallic alloys and oxidation/sulfidation resistant coatings; fabrication processes; high temperature filters; gas separation ceramic membranes; solid state electrolytes; and carbon fiber composite molecular sieves. Continue support of high priority activities that contribute substantially to the efficiency of advanced power systems, including ceramic composite heat exchangers, nondestructive evaluation techniques, fuel cells; and oxide dispersion strengthened iron aluminides. (\$5,173) (ANL, INEL, ORNL, PNL)

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
CROSSCUTTING Materials (Cont'd)	alloys and an advanced coating process. (\$4,887) (ANL, INEL, PNL, ORNL, ORO)		
	No activity. (\$0)	No activity. (\$0)	Initiate solicitation to support break- through concepts to develop materials capable of achieving very low cost hydrogen and oxygen separation from mixed gas streams. These are critical enabling technologies to be able to deploy advanced fossil energy ultra-clean fuel and power systems. (\$990) (TBD)
	Fund technical and program management support. (\$51)	Fund technical and program management support. (\$52)	Fund technical and program management support. (\$62)
	\$4,938	\$5,225	\$6,225

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Technology Crosscut Environmental Activities	Continue analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continue emission trends and forecast studies. (\$2,011) (ANL, ICF, Resource Dynamics, ITSO, TMS, ITCORP, PNL, TBD)	Continue analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continue emission trends and forecast studies. (\$1,997) (ANL, ICF, Resource Dynamics, ITSO, TMS, ITCORP, PNL, TBD)	Continue analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continue emission trends and forecast studies. (\$1,980) (ANL, ICF, Resource Dynamics, ITSO, TMS, ITCORP, PNL, TBD)
	Provide environmental, safety and health, safeguards and security and National Environmental Policy Act (NEPA) assistance and assessment support to field offices. (\$224) (TMS)	Provide environmental, safety and health, safeguards and security and National Environmental Policy Act (NEPA) assistance and assessment support to field offices. (\$222) (TMS)	Provide environmental, safety and health, safeguards and security and National Environmental Policy Act (NEPA) assistance and assessment support to field offices. (\$220) (TMS)
	\$2,235	\$2,219	\$2,200

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
CROSSCUTTING Technical and Economic Analysis	Continue studies supporting multi-year planning, FE strategy and program formulation; conduct contract studies on issues that crosscut FE programs including strategic benefits of new fossil fuel technology; provide analytical support for fossil related Energy Policy Act implementation. Support State and regional efforts to develop energy analysis capability. (\$760) (ANL, ICF, EIA, Resource Dynamics, TMS, CO School of Mines, ITCORP, TBD)	Continue studies supporting multi-year planning, FE strategy and program formulation; conduct contract studies on issues that crosscut FE programs including strategic benefits of new fossil fuel technology; provide analytical support for fossil related Energy Policy Act implementation. Conduct critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. (\$775) (ANL, ICF, EIA, Resource Dynamics, TMS, CO School of Mines, ITCORP, TBD)	Continue studies supporting multi-year planning, FE strategy and program formulation; conduct contract studies on issues that crosscut FE programs including strategic benefits of new fossil fuel technology; provide analytical support for fossil related Energy Policy Act implementation. Conduct critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. (\$1,000) (ANL, ICF, EIA, Resource Dynamics, TMS, CO School of Mines, ITCORP, TBD)
	\$760	\$775	\$1,000

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
CROSSCUTTING International Program Support	Provide DOE's contribution for partial funding of selected activities of the International Energy Agency (IEA). IEA Coal Research and provide programmatic support for the FE representative to IEA. (\$609) (IEA)	Continue Fossil Energy's effort with the IEA program. Continue to collaborate with a variety of international organizations to insure the U.S. clean coal interests are represented; and bilaterally to continue to work with countries to assure that cleaner energy technologies are deployed. (\$651) (TBD)	Support Fossil Energy R&D Program Managers in developing collaborative technical activities with international performers in the coal and advanced power system area. Maintain active relationships with international organizations such as the World Energy Council (WEC) and United States Energy Association (USEA). Join with other coal-using and coal-producing nations in funding expert-level analyses and reviews of coal supplies and characteristics, technology and economics of coal utilization, pathways for mitigation of environmental impacts, and international financing of coal projects and other topics as conducted by the International Energy Agency Coal Research (IEACR) and widely distributed to users in the U.S. Continue support of programmatic efforts in the Pacific Rim and focus on activities

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
International Program Support (Cont'd)			in China. Initiate Environment Corp activities in conjunction with the U.S. China Energy and Environmental Center function. (\$1,150) (TBD)
	\$609	\$651	\$1,150
CROSSCUTTING Technology Crosscut, Subtotal	\$3,604	\$3,645	\$4,350
University/National Laboratory Coal Research - HBCUs, Education and Training	Support an expanded HBCU annual technology transfer symposium (to include other minority institutions) and research activities (8 to 10 awards) (open competition to 117 HBCUs and other minority institutions). (\$906) (TBD)	Support an expanded HBCU annual technology transfer symposium (to include other minority institutions) and research activities (8 to 10 awards) (open competition to 117 HBCUs and other minority institutions). (\$923) (TBD)	Support an expanded HBCU annual technology transfer symposium (to include other minority institutions) and research activities (8 to 10 awards) (open competition to 117 HBCUs and other minority institutions). (\$990) (TBD)
	Fund technical and program management support. (\$10)	Fund technical and program management support. (\$9)	Fund technical and program management support. (\$10)
	\$916	\$932	\$1,000
CROSSCUTTING, Subtotal	\$9,458	\$9,802	\$11,575

III. **Performance Summary**: ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Research and Technology Development, Total	\$17,352	\$17,579	\$23,579

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

NATURAL GAS RESEARCH

I. **Mission Supporting Goals and Objectives:**

The gas program supports Congressional and Administration goals to expand the use of our cleanest fossil fuel -- natural gas. The large domestic resource, competitive cost and clean burning characteristics of natural gas give it a large and expanding role in the total energy supply for the United States. To expand the use of natural gas, DOE is researching, developing, and demonstrating clean, affordable technologies that will decrease the costs of finding producing, storing, and using gas; increase the reliability of gas supply; and use gas more efficiently.

The Natural Gas Research Program is encouraging closer partnerships with other Federal agencies, State and local governments, and industry as well as promoting increased cost-sharing and industry-focused programs. DOE cooperates with the Federal Energy Regulatory Commission (FERC) on regulatory issues that have an impact on gas delivery and utilization and corresponding research, development and demonstration (RD&D) programs. DOE provides comments and analysis on regulations proposed by the U.S. Environmental Protection Agency (EPA), the Department of the Interior and other agencies that may affect gas supply and utilization. DOE program staff also serve on State and Federal interagency workgroups involving gas production, transportation, storage, distribution, and utilization. The DOE works cooperatively with organizations, such as the Interstate Oil and Gas Compact Commission, to improve State programs regulating the environmental aspects of gas exploration and production, and to ascertain the effect that State regulatory programs have on gas resource recovery.

Cooperation with industry and States will continue to be in the form of joint RD&D projects and technology transfer activities. These projects will be cost-shared in a way that will assure greater involvement of States and industry in program activities and provide the opportunity to share in project management. Industry cost-sharing of gas RD&D projects averages 25 to 30 percent, and increases to 50 percent and higher as RD&D efforts move from the research to the demonstration phase.

The overall goal of the Natural Gas RD&D Program is to improve the Nation's ability to supply, store, transport, distribute, and utilize

I. **Mission Supporting Goals and Objectives:** NATURAL GAS RESEARCH (Cont'd)

gas in an economic, efficient, and environmentally beneficial manner. In support of DOE's mission the program funds activities that contribute toward: lowering costs for finding and producing gas; improving the confidence in the continued availability of a long-term gas supply (Exploration and Production Area); improving the quality and utility of natural gas for the consuming public (Utilization Area); developing improved and less costly means of delivering and storing gas (Delivery & Storage Area); developing and ensuring availability of low cost environmental compliance technology, and reducing regulatory barriers to economic and efficient market operations by promoting coordinated and innovative Federal and State regulations (Environmental/Regulatory Impact Area). Each program area has its own unique mission that contributes to the goals and mission of the overall Natural Gas Research Program. The total program will increase the value of the domestic natural gas resource base for gas consumers, for Federal, State, and local governments and for the gas industry.

Exploration and Production (formerly Resource and Extraction): The Office of Fossil Energy will continue to fund basic and applied RD&D in the Exploration and Production Program Area. Specifically, in the Drilling Completion and Stimulation product line funding is requested to: develop and demonstrate a set of tools and techniques that (a) result in minimum damage during the drilling, completion, and fracturing stages to particular formations, (b) reduce the cost and improve the effectiveness of gas recovery from mature fields, and (c) minimize overall environmental impact of drilling-related operations and waste disposal. In the Low Permeability Formations product line funding is requested to: test the tools & techniques developed by the detailed engineering assessments in fields identified as having the highest probability of success, thereby, (a) stimulating the use of advanced technology, (b) identifying the limits of current basic and applied geoscience research, (c) refocusing/refining the direction of future basic and applied geoscience research. In the Resource and Reserves product line funding is requested to: develop more detailed engineering assessments of the existing and undiscovered natural gas resource base in order to (a) validate the existence, location, and recovery economics of the vast quantities of the discovered but unproven and undiscovered natural gas estimated by the Department of the Interior, (b) reduce the perceived risk associated with investment in natural gas supply projects, and (c) increase the recovery effectiveness, and extend the productive life of mature natural gas fields. In addition, two new activities will be initiated: (1) Gas hydrate diagnostics to locate deposits offshore for subsequent assessment of gas supply potential, and (2) Stripper gas wells where attempts will be made to extend the productive life of active low rate wells (currently contributing 5% of the domestic gas supply).

Natural Gas Storage: Advanced technology research and demonstration projects are directed to increase the consumer benefits from existing underground storage facilities, reduce the investment required to maintain effective economic storage service, and to provide alternative storage facilities required for the development of new storage capacity. Efforts are focused to develop cost-effective

I. **Mission Supporting Goals and Objectives:** NATURAL GAS RESEARCH (Cont'd)

technologies and engineering techniques that can determine well damage mechanisms and prevent or remediate storage field deliverability decline, expand peaking storage capacity to meet gas requirements during high demand periods, and to develop real-time storage measurement technologies to reduce uncertainties in storage inventories attributable to storage metering biases.

Emerging Processing Technology Applications: The primary focus of these efforts is to develop technologies needed to prepare for transport and /or use natural gas that is low quality in composition and/or in locations remote from conventional pipelines, e.g., Alaska North Slope, and Gulf of Mexico. Subprogram efforts include development of advanced membrane and other separation technologies to enhance hydrogen sulfide (H₂S), carbon dioxide (CO₂) and nitrogen (N₂) removal from raw gas that is below pipeline quality; development of innovative processes to chemically convert natural gas to readily transportable, competitively priced liquid transportation fuels as well as blending agents able to improve the environmental acceptability of petroleum-based fuels; and other advanced efforts to upgrade, concentrate and otherwise ready natural gas for use. Collaborative program efforts initiated in FY 1998 with Fossil Energy's coal transportation fuels program and Energy Efficiency and Renewable's Heavy Vehicle Technologies and Hydrogen programs in furthering applicable Fischer-Tropsch gas-to-liquids technology and advanced motor vehicle fuel production will continue.

Advanced Turbine Systems (ATS): Efforts are directed to developing a new level of gas turbine efficiency, reliability and clean burning capability that promised to improve and maintain electric power generation advantages of natural gas. These efforts constitute a major Administrative initiative and work is being conducted with a consortium of industry participants. Successful development of a suite of ultra-high efficiency (exceeding 60%) turbines is expected to expand U.S. technology export potentials to meet the growing demand for electricity in other nations. Advanced Turbine Systems offer innovative approaches in support of climate change initiatives and are a major part of the Vision 21 concept. Although ATS has specifically identified goals, these goals dovetail with Vision 21 concepts in the 2010 to 2015 timeframe.

Funding for environmental research activities will bring credible scientific information and advanced technologies to address the environmental issues that have been identified by industry, and state and federal regulators as highest priority. In FY 1998, the program will focus on detection and control of air emissions from gas equipment and facilities, treatment of produced water to meet environmental standards, remediation of soils that have been contaminated with hydrocarbons or produced water, treatment and disposal of wastes containing naturally occurring radioactive materials, and other approaches to manage oil and gas field wastes. The program works to lower the cost of effective environmental protection in these environmental issue areas through a combination of risk

I. **Mission Supporting Goals and Objectives:** NATURAL GAS RESEARCH (Cont'd)

assessment, technology development, regulatory streamlining, impact analysis, and facilitating dialogue that attempts to achieve consensus among the affected parties on ways to balance the need to develop the nation's energy resources with the maintenance of our environmental values.

II. A. **Funding Schedule:** NATURAL GAS RESEARCH

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Exploration and Production	\$13,772	\$13,932	\$13,432	\$-500	-4%
Delivery and Storage	975	993	1,000	7	1%
Advanced Turbine Systems	45,433	45,000	43,000	-2,000	-4%
Emerging Processing Technology Applications	5,697	7,808	7,308	-500	-6%
Effective Environmental Protection	<u>2,580</u>	<u>3,267</u>	<u>2,617</u>	<u>-650</u>	<u>-20%</u>
Total, Natural Gas Research	<u>\$68,457</u>	<u>\$71,000</u>	<u>\$67,357</u>	<u>\$-3,643</u>	<u>-5%</u>

II. B. **Laboratory and Facility Funding Schedule:**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Argonne National Lab (East)	\$550	\$805	\$900	\$95	12%
Idaho National Engineering Lab	400	870	620	-250	-29%
Lawrence Berkeley Lab	532	500	600	100	20%
Los Alamos National Laboratory	400	450	500	50	11%
Federal Energy Technology Center	3,198	2,541	3,155	614	24%
Oak Ridge National Lab	1,700	1,700	1,700	0	0%
Pacific Northwest Laboratory	0	200	200	0	100%
Sandia National Laboratories	470	549	650	101	18%
All Other	<u>61,207</u>	<u>63,585</u>	<u>59,232</u>	<u>-4,353</u>	<u>-7%</u>
Total, Natural Gas Research	<u>\$68,457</u>	<u>\$71,000</u>	<u>\$67,357</u>	<u>\$-3,643</u>	<u>-5%</u>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Exploration and Production	<p>Drilling, Completion, and Stimulation (DCS): (\$5,477)</p> <p>Continue support of industry led cooperative research, development, and deployment of reduced-cost products and higher efficiency processes. Continue development and field testing of high rate-of-penetration, slimhole, directional/extended reach, and underbalanced drilling products; and of advanced completion technologies. Continue testing, deployment, and technology transfer of underbalanced drilling technology and minimum formation damage drilling and fracturing. Continue fracturing research with the GRI at Oklahoma University. Initiate development of a revolutionary/smart drilling system. (\$5,477) (FETC, CER, Smith Int'l, Oklahoma Univ., Maurer, GeoScience Elec., UPRC Consortium, FlowDril, PCS/Universal, Drilling Eng'g Assoc., TBD, NL-TBD)</p>	<p>Drilling, Completion, and Stimulation (DCS): (\$5,531)</p> <p>Continue support of industry led cooperative research, development, and deployment of reduced-cost products and cleaner, higher efficiency processes. Continue development and field testing of high rate-of-penetration, slimhole, directional, and underbalanced drilling products; and of advanced completion technologies. Continue testing, deployment, and technology transfer of underbalanced drilling technology and minimum formation damage drilling and fracturing. Continue fluid fracture research with the GRI at Oklahoma University. Initiate development of steerable mud hammer drilling and of underbalanced closed loop drilling, and development of a revolutionary drilling system. (\$5,531) (FETC, Smith Int'l, Oklahoma Univ., Sperry Sun, PCS/Universal, Drilling Eng'g</p>	<p>Drilling, Completion, and Stimulation (DCS): (\$5,000)</p> <p>Continue support of industry led cooperative research, development, and deployment of reduced-cost products and cleaner, higher efficiency processes. Continue development and field testing of high rate-of-penetration, slimhole, directional, and underbalanced drilling products; and of advanced completion technologies. Continue testing, deployment, and technology transfer of underbalanced drilling technology and minimum formation damage drilling and fracturing. Continue fluid fracture research with the GRI at Oklahoma University. Continue development of a revolutionary drilling system. Continue participation in the National Lab Partnership program. (\$5,000) (FETC, Oklahoma Univ., EG&G, Maurer/Halburton, Sperry Sun, Drilling Eng'g Assoc., LLNL, LANL, Novatek, Mauer,</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Exploration and Production (Cont'd)		Assoc., Maurer, LLNL, LANL, EG&G, Novatek, Tempres Tech, Tech Intl., Penn State, TBD)	Tempres, Tech Intl., Penn State, TBD)
	Low-Perm Formations: (\$4,536)	Low-Perm Formations: (\$4,578)	Low-Perm Formations: (\$3,993)
	Continue research in low-permeability reservoir field deployment with industry in the Greater Green River and other priority basins. Continue development of diagnostics for evaluating and other characterization of natural fractured gas reservoirs and use of advanced National Laboratory capabilities. (\$4,536) (FETC, LBL, SNL, Coleman, Adv. Res., UPR, TBD)	Continue research in low-permeability reservoir field deployment with industry in the Greater Green River and other priority basins. Continue development of diagnostics for imaging and predicting gas in natural fractured reservoirs, conducting advanced geoscience measurements including seismic processing and interpretation, and use of advanced National Laboratory capabilities. Initiate technology support work for development of gas hydrates program. (\$4,578) (EG&G, LBL, SNL, Coleman, Adv. Res., UPRC, INEL, USGS, NRL)	Continue research in low-permeability reservoir field deployment with industry in the Greater Green River and other priority basins. Continue development of diagnostics for imaging and predicting gas in natural fractured reservoirs, conducting advanced geoscience measurements including seismic processing and interpretation, and use of advanced National Laboratory capabilities. (\$3,993) (EG&G, LBL, SNL, Coleman, Adv. Res., UPRC, INEL, TBD)

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Exploration and Production (Cont'd)	<p>Resources and Reserves: (\$3,619)</p> <p>Continue development of a natural gas data system, including atlases and system models for both conventional and unconventional reservoirs. Continue collaborative effort with USGS on U.S. resource/reserves studies. Continue additional secondary gas recovery studies in carbonate reservoirs in the Permian Basin. Continue gas technology transfer efforts. Continue natural gas product market analyses. (\$3,619) (FETC, EEA, ICF, BEG, MMS, USGS, TBD, NL-TBD)</p>	<p>Resources and Reserves: (\$3,684)</p> <p>Continue development of a natural gas data system, including atlases and system models for both conventional and unconventional reservoirs. Continue collaborative effort with USGS on U.S. resource/reserves assessments. Continue additional secondary gas recovery studies in Appalachian Basin formations and in carbonate reservoirs in the Permian Basin. Continue gas technology transfer efforts. Continue natural gas product market and system analyses for use in planning and analysis of cost-effective recovery processes. (\$3,684) (EG&G, EEA, ICF, BEG, USGS, K&M, Marine Board, PTTC, Scrato, CSM, WV Consortium, TBD)</p>	<p>Resources and Reserves: (\$3,305)</p> <p>Continue development of a natural gas data system, including atlases and system models for both conventional and unconventional reservoirs. Continue collaborative effort with USGS on U.S. resource/reserves assessments. Continue additional secondary gas recovery studies in Appalachian Basin formations and in carbonate reservoirs in the Permian Basin. Continue gas technology transfer efforts. Continue natural gas product market and system analyses for use in planning and analysis of cost-effective recovery processes. (\$3,305) (EG&G, EEA, ICF, BEG, PTTC, USGS, Univ. TX, Marine Board, K&M, U of WV Consort., TBD)</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production (Cont'd)	No activity. (\$0)	No activity. (\$0)	Gas Hydrates: (\$500)
			Initiate diagnostics to locate gas hydrate deposits in offshore and onshore environments and characterize resource for subsequent assessment of supply potential. (\$500) (USGS, NRL, Colo. Sch. Of Mines, TBD)
	No activity. (\$0)	No activity. (\$0)	Stripper Gas Wells (\$500)
			Conduct engineering assessment of wells to determine candidate areas for restimulation tests; test and evaluate via field tests the effect of revitalization efforts to extend the productive life of the well. (\$500) (TBD)
	Provide technical and program management support. (\$140)	Provide technical and program management support. (\$139)	Provide technical and program management support. (\$134)
	\$13,772	\$13,932	\$13,432

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Delivery and Storage	Continue a program with industry to develop deliverability revitalization and enhancement technology, advanced storage concepts, and advanced gas measurement. Continue support of storage CRADA opportunities and product market analysis. (\$965) (FETC, ARI, TBD)	Continue a program with industry to develop deliverability revitalization and enhancement technology, advanced storage concepts, and advanced gas measurement. Initiate improved remedial technologies and improved storage in salt formation. Continue support of storage CRADA opportunities and product market analysis. (\$983) (EG&G, K&M, Halliburton, SWRI, MSU, ARI, TBD)	Continue a program with industry to develop deliverability revitalization and enhancement technology, direct energy metering, and advanced gas measurement. Initiate improved remedial technologies to improve storage. Continue support of storage CRADA opportunities and product market analysis. (\$990) (FETC, ARI, ICF, TBD)
	Provide technical and program management support. (\$10)	Provide technical and program management support. (\$10)	Provide technical and program management support. (\$10)
	\$975	\$993	\$1,000
Advanced Turbine Systems	Continue the advanced turbine systems ultra high efficiency gas turbine technology program. Continue technology base development including: Univ. consortium, in-house research, manufacturing technologies, combustion and coal application. (\$9,583) (SCERDC, FETC, ABB, ORNL, Pratt/Whitney)	Continue the advanced turbine systems ultra high efficiency gas turbine technology program. Continue technology base development including: Univ. consortium, in-house research, manufacturing technologies, combustion and coal application. (\$9,879) (SCERDC, FETC, Prate/Whitney, ORNL, ABB)	Continue the advanced turbine systems ultra high efficiency gas turbine technology program. Continue technology base development including: Univ. Consortium, in-house research, manufacturing technologies, address fuel flexibility application. (\$8,570) (SCERDC, FETC, Pratt/Whitney, ORNL)

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Turbine Systems (Cont'd)	<p>Natural Gas Initiative:</p> <p>Continue the investment program for Natural Gas through an accelerated advanced turbine systems program. Continue utility system component development efforts. Continue full-scale component/sub-system testing. (\$35,384) (GE, Westinghouse)</p> <p>Provide technical and program management support. (\$466)</p> <p>\$45,433</p>	<p>Natural Gas Initiative:</p> <p>Continue the investment program for Natural Gas through an accelerated advanced turbine systems program. Continue utility system component development efforts. Continue full-scale component/sub-system testing. (\$34,671) (GE, Westinghouse)</p> <p>Provide technical and program management support. (\$450)</p> <p>\$45,000</p>	<p>Natural Gas Initiative:</p> <p>Continue the investment program for Natural Gas through an accelerated advanced turbine system program. Complete full-scale component/sub-system testing and engine manufacturing. Initiate site erection and preparation for full speed test. (\$34,000) (GE, Westinghouse)</p> <p>Provide technical and program support. (\$430)</p> <p>\$43,000</p>
Emergin Processing Technology Applications (Cont'd)	<p>Gas-to-Liquids: Continue assessment of gas conversion feasibility for gas in Alaska, the Gulf of Mexico, and other remote locations; continue, cost-shared development of advanced chemical conversions and small scale</p>	<p>Gas-to-Liquids: Monitor gas-to-liquids feasibility factors for remote gas in Alaska, Gulf of Mexico, and other domestic locations. Continue cost-shared development of innovative hydrogen plasma, chemical, and</p>	<p>Gas-to-Liquids: Monitor and evaluate gas-to-liquids feasibility factors for remote gas in Alaska, Gulf of Mexico and other domestic locations as stand-alone operations and/or with other power or energy conversion technology. Continue</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Emerging Processing Technology Applications (Cont'd)	physical conversion of gas to transportable liquids; and continue small, basic research activities. (\$4,233) (INEL, LANL/Cryenco, Energy Int'l, Univ. of OK, MIT, CANMET, BRSC, Dow-Corning, TBD, FETC, FETC)	physical conversion technologies for the production of transportable liquids from natural gas. Continue basic exploratory research activities of novel concepts. Continue material, seal, and reactor development of novel ceramic membrane technology for enhancing natural gas utilization in the production of environmentally superior fuels, high-value chemicals and hydrogen. Initiate support activities pertaining to Fischer-Tropsch catalysts and reactor for natural gas conversion to produce environmentally superior liquid fuels. (\$6,297) (INEL, LANL, Cryenco, CANMET, Univ. of OK, LBL, FETC, TBD)	basic exploratory research activities of novel conversion concepts. Continue cost-shared development of innovative hydrogen plasma pyrolysis and other chemical conversion, and small-scale physical conversion technologies for the production of transportable liquids from natural gas. Continue material, seal and reactor development of novel ceramic membrane technology for enhancing Fischer-Tropsch gas conversion process to produce environmentally superior liquid fuels and hydrogen. Liquids include low emission, high performance motor vehicle fuel blends at competitive costs and suitable for existing as well as advanced engines under development with DOE/EE program support. (\$5,302) (INEL, LANL-Cryenco, K&M, LBNL, Okla Univ., Air Products, Eltron, Cerametec, ANL, B&W, Arco, Chevron, PNL, Pa. State U., U. of Pa., FETC, TBD)

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Emerging Processing Technology Applications (Cont'd)	<p>Gas Tech Information: Continue support of an international center for information on natural gas technologies. (\$312) (GTI)</p> <p>Gas Upgrading: Continue research in low-quality gas upgrading, including development of improved sulfur removal processes and development of advanced concepts of readying high nitrogen unmarketable gas for use. (\$1,094) (FETC, ARCTECH, Syracuse, MTRI, SRI, IGT, Texas A&M, NIST, TBD)</p> <p>Provide technical and program management support. (\$58)</p> <p>\$5,697</p>	<p>Gas Tech Information: Continue support of an international center for information on natural gas technologies. (\$318) (GTI)</p> <p>Gas Upgrading: Continue research in low-quality gas upgrading, including development of improved sulfur removal processes and development of advanced concepts of readying high nitrogen unmarketable gas for use. Initiate development of advanced hybrid gas separation technologies. (\$1,115) (FETC, Arctech, SNL, MTRI, SRI, IGT, Texas A&M, TBD)</p> <p>Provide technical and program management support. (\$78)</p> <p>\$7,808</p>	<p>Gas Tech Information: Continue support of an international center for information on natural gas technologies. (\$318) (GTI)</p> <p>Gas Upgrading: Continue research in low-quality gas upgrading, including development of improved sulfur removal processes and development of advanced concepts of readying high nitrogen unmarketable gas for use. Continue development of advanced hybrid gas separation technologies. Continue multi-strata upgrading and utilization. (\$1,615) (FETC, Arctech, SNL, MTR, SRI, Texas A&M, TBD)</p> <p>Provide technical and program management support. (\$73)</p> <p>\$7,308</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Effective Environmental Protection	<p>Program Planning Data Analysis:</p> <p>Continue data collection and the development of analytical tools for program planning, outreach and technology transfer consistent with the Domestic Natural Gas and Oil Initiative, including the capability to quantify environmental costs and assess constraints to gas resource recovery (\$260). Perform legislative and regulatory impact analysis related to both upstream and downstream gas environmental issues (\$100) (Total \$360) (ICF, ANL, TBD)</p>	<p>Program Planning Data Analysis:</p> <p>Continue data collection and the development of analytical tools for program planning, outreach and technology transfer consistent with the Domestic Natural Gas and Oil Initiative, including the capability to quantify environmental costs and assess constraints to gas resource recovery. Perform legislative and regulatory impact analysis related to both upstream and downstream gas environmental issues. (\$425) (ANL, TBD)</p>	<p>Program Planning Data Analysis:</p> <p>Continue data collection and the development of analytical tools for program planning, for outreach and technology transfer, including the capability to quantify environmental costs and assess constraints to gas resource recovery, collection and distribution. Continue to perform legislative and regulatory impact analysis related to both upstream and downstream gas environmental issues. (\$425) (TBD, ICF)</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Effective Environmental Protection (Cont'd)	<p>Technology Development:</p> <p>Continue efforts to develop and demonstrate technologies and methods for improving the economics and environmental performance of gas exploration and production operations related to produced water and waste management, including methods that enable operators to define options and costs of alternative environmental compliance strategies application of advanced research at National Laboratories, and new methods of remote sensing of leak detection from pipelines. (\$509) (SNL, TBD, Greenhill, BPF, SELA Univ. labs)</p>	<p>Technology Development:</p> <p>Continue efforts to develop and demonstrate technologies and methods for improving the economics and environmental performance of gas exploration, production, operations, processing and transportation including methods that enable operators to define options and costs of alternative environmental compliance strategies application of advanced research and new methods of detecting and controlling air emission from gas equipment and facilities. (\$1,155) (TBD, BPF, SELA Univ, SNL, Greenhill)</p>	<p>Technology Development:</p> <p>Continue efforts to develop and demonstrate technologies and methods for improving the economics and environmental performance of all facets of gas supply including methods that enable operators to define options and costs of alternative environmental compliance strategies, application of advanced research and new methods of detecting and controlling air emissions (including particulate matter from gas equipment and facilities). (\$642) (TBD, Greenhill)</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Environmental Protection (Cont'd)	<p>Outreach and Technology Transfer:</p> <p>Continue outreach and technology transfer efforts on environmental issues affecting natural gas supply, including compliance efforts with industry, states and others to identify and address environmental challenges to expanded natural gas production. (\$160) (IOGCC)</p> <p>NORM Treatment and Disposal:</p> <p>Continue pilot test of NORM treatment and disposal alternative to reduce the compliance cost burden on natural gas operators. Continue quality assurance, monitoring and independent risk assessment for all field work. Continue NEPA activities in support of the NORM treatment and disposal project. (\$1,525) (ANL, TBD, BPF)</p>	<p>Outreach and Technology Transfer:</p> <p>Continue outreach and technology transfer efforts on environmental issues affecting natural gas supply, including compliance efforts with industry, states and others to identify and address environmental challenges to expanded natural gas production. (\$150) (IOGCC)</p> <p>NORM Treatment and Disposal:</p> <p>Conduct pilot test of NORM treatment and disposal alternative to reduce the compliance cost burden on natural gas operators. Continue quality assurance, monitoring and independent risk assessment for all field work. Continue NEPA activities in support of the NORM treatment and disposal project, and outreach activities. (\$1,504) (ANL, TBD, BPF, Univ. of Miss.)</p>	<p>Outreach and Technology Transfer:</p> <p>Continue outreach and technology transfer efforts on environmental issues affecting natural gas supply, including compliance efforts with industry, states, and others to identify and address environmental challenges to expanded natural gas production. (\$350) (IOGCC)</p> <p>NORM Treatment and Disposal:</p> <p>Continue to evaluate NORM treatment and disposal alternatives, including off-shore facilities to reduce the compliance cost burden to natural gas operators. Continue cooperative efforts with states and industry to establish scientifically based regulations. Continue NORM risk studies with participating states. (\$1,174) (TBD, Natl. Labs, State of Mississippi)</p>

III. **Performance Summary**: NATURAL GAS RESEARCH (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Environmental Protection (Cont'd)	Provide technical and program management support. (\$26)	Provide technical and program management support. (\$33)	Provide technical and program management support. (\$26)
	\$2,580	\$3,267	\$2,617
Natural Gas Research, Total	\$68,457	\$71,000	\$67,357

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

FUEL CELLS

I. **Mission Supporting Goals and Objectives:**

The objectives of the Fuel Cells Program in support of the Energy Policy Act are: (1) to support technology base development of fuel cell systems to provide highly efficient, environmentally superior technology for the generation of electrical and thermal energy for electric utility, industrial, and commercial/residential markets; and (2) strengthen the national economy by providing technologies that improve U.S. international competitiveness in this new manufacturing industry and by generating export sales for technology/products. Specific objectives are: Near-term (to year 2002) - develop and demonstrate high efficiency, environmentally clean, gas-fueled, multi-kilowatt, on-site cogeneration, low megawatt distributed generation powerplants, and multi megawatt electric utility powerplants to position industry to commercially introduce these powerplants at competitive costs; Mid-term (to year 2010) - develop and demonstrate the advancements in fuel cell technology and combined cycle fuel cell heat engine technology which will enable industry to significantly penetrate all markets for high efficiency gas-based systems and commercially introduce coal-fueled, multimegawatt powerplants at competitive costs; Long-term (to year 2030) - develop and demonstrate the critical high risk technology advancements which will permit U.S. industry to establish commercial availability of advanced, ultra-high efficiency, integrated fuel cell systems. These systems offer the prospect of reducing criteria pollutants well below current New Source Performance Standard levels, reducing non-criteria pollutants such as CO₂ and acid rain precursors, and reducing thermal emissions to the environment. These reductions are achieved through the ultra-high efficiency and the inherently low emissions of fuel cell systems. First generation phosphoric acid systems have reached commercial status and market entry units are attempting to overcome cost barriers typical of new products. Higher system efficiencies and lower costs are forecast for advanced molten carbonate and solid oxide fuel cell systems, the second generation systems, which will be introduced using natural gas and later operated on gas and coal in multiple end-use sectors..

Fuel cell systems offer innovative approaches in support of climate change initiatives and are a major part of the Vision 21 concept in the Advanced Power Systems Technology area. Although fuel cell systems have specifically identified goals, these goals dovetail with Vision 21 concepts in the 2010 to 2015 time frame.

I. **Mission Supporting Goals and Objectives:** FUEL CELLS (Cont'd)

The Advanced Research subactivity supports the program objectives by studying critical enabling science and technology topics related to research on fuel cells, to better understand the basis of the underlying processes involved and to explore novel concepts. The results of the investigations are used by those who develop, design, manufacture and operate fuel cell systems which include the molten carbonate and solid oxide systems discussed above. Advanced research of fuel cell power systems seeks to capitalize on their intrinsic high efficiency and their environmentally benign characteristics, emphasizing research on electrochemistry, catalysis, interconnections, and materials interactions for molten carbonate, solid oxide and advanced devices.

The Office of Fossil Energy plans to continue cooperative efforts with the Department of Defense and private industry in actions to accelerate commercialization of fuel cells.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Advanced Research	\$1,186	\$1,210	\$1,200	-10	-1%
Molten Carbonate Systems	35,446	0	0	0	??
Advanced Concepts	12,172	0	0	0	??
Fuel Cell Systems Development	0	39,000	41,000	44,800	100%
Total, Fuel Cells	<u>\$48,804</u>	<u>\$40,210</u>	<u>\$42,200</u>	<u>\$1,990</u>	<u>5%</u>

II. B. **Laboratory and Facility Funding Schedule:**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Argonne National Lab (East)	\$920	\$820	\$1,150	\$330	40%
Pacific Northwest Lab	400	290	290	0	0%
Federal Energy Technology Center	556	100	200	100	100%
All Other	<u>46,928</u>	<u>39,000</u>	<u>40,560</u>	<u>1,560</u>	<u>4%</u>
Total, Advanced Clean Fuels Research	<u>\$48,804</u>	<u>\$40,210</u>	<u>\$42,200</u>	<u>\$1,990</u>	<u>-1%</u>

III. **Performance Summary:** FUEL CELLS

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Research	<p>This program conducts generic research to capitalize on the intrinsic high efficiency and environmentally benign characteristics of advanced fuel cells. Research will be continued on molten carbonate and solid oxide electrodes, electrolytes and interconnects; solid oxide advanced materials and seals; and thin film advanced cell processing techniques. Funding for two cooperative research and development agreements between national laboratories and fuel cell manufacturers will be continued. (\$1,174) (ANL, PNL, TBD)</p> <p>Fund technical and program management support. (\$12)</p> <p>\$1,186</p>	<p>This program conducts generic research to capitalize on the intrinsic high efficiency and environmentally benign characteristics of advanced fuel cells. Research will be continued on molten carbonate and solid oxide electrodes, electrolytes and interconnects; solid oxide advanced concepts, materials and seals; and thin film advanced cell processing techniques. Funding for a cooperative research and development agreement between a national laboratory and a fuel cell manufacturer will be continued. (\$1,198) (ANL, PNL, TBD)</p> <p>Fund technical and program management support. (\$12)</p> <p>\$1,210</p>	<p>This program conducts generic research to capitalize on the intrinsic high efficiency and environmentally benign characteristics of advanced fuel cells. Research will be continued on molten carbonate and solid oxide electrodes, electrolytes and interconnects; solid oxide advanced concept, material and seals; and thin film advanced cell processing techniques. Funding for a cooperative research and development agreement between a national laboratory and a fuel cell manufacturer will be continued. (Total \$1,188) (ANL, PNL, TBD)</p> <p>Fund technical and program management support. (\$12)</p> <p>\$1,200</p>

III. **Performance Summary:** FUEL CELLS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Molten Carbonate Systems	Continue cost-shared cost reduction and performance improvement on a stretched out basis on two systems for market entry by the private sector. (\$34,092) (MC Power, ERC)	No activity. (\$0)	No activity. (\$0)
	Support R&D included above. Continue at a reduced level economic and market study assessments (\$200), corrosion studies (\$100), system assessments and evaluations (\$350), and component development (\$340). (Total \$990) (METC, ADL, ANL, ERC, TBD)	No activity. (\$0)	No activity. (\$0)
	Continue technical and program management support. (\$364)	No activity. (\$0)	No activity. (\$0)
	\$35,446	\$0	\$0

III. **Performance Summary:** FUEL CELLS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Concepts	Conduct cost-shared cost reduction and product improvement for tubular SOFC at a reduced level for market entry by the private sector. (\$12, 047) (Westinghouse)	No activity. (\$0)	No activity. (\$0)
	Continue technical and program management support. (\$125)	No activity. (\$0)	No activity. (\$0)
	\$12,172	\$0	\$0
Fuel Cell Systems Development	No activity. (\$0)	Continue cost-shared cost reduction and performance improvement on a stretched out basis on two systems for market entry by the private sector. (\$24,147) (MC Power, ERC)	Continue cost-shared cost reduction and performance improvement on a stretched out basis on two systems for market entry by the private sector. (\$26,360) (MC Power, ERC)

III. **Performance Summary:** FUEL CELLS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Fuel Cell Systems Development (Cont'd)	No activity. (\$0)	Support R&D included above. Continue at a reduced level economic and market study assessments (\$200), corrosion studies (\$100), electrode life verification (\$270), and component development (\$413). (Total \$983) (ADL, ANL, ERC, TBD)	Support R&D included above. Continue at a reduced level economic and market study assessments (\$200), system assessments and evaluations (\$100), corrosion studies (\$100), electrode life verification (\$250), and component development (\$400). (Total \$1,050) (ADL, FETC, ANL, TBD)
	No activity. (\$0)	Conduct cost-shared cost reduction and product improvement for tubular SOFC for market entry by the private sector (\$13,330). Continue SOFC support at ORNL (\$150). (Total \$13,480) (Westinghouse, ORNL)	Continue cost-shared cost reduction and production improvement for tubular SOFC systems for market entry by the private sector. (\$13,180) (Westinghouse)
	No activity. (\$0)	Continue technical and program management support. (\$390)	Continue technical and program management support. (\$410)
	\$0	\$39,000	\$41,000
Fuel Cells, Total	\$48,804	\$40,210	\$42,200

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

OIL TECHNOLOGY

I. **Mission Supporting Goals and Objectives:**

The oil technology program in concert with its customers, conducts and promotes activities and policies to enhance the efficiency and environmental quality of domestic oil operations.. The success of these programs will help our Nation achieve a reliable economic oil supply and enhance technology leadership while protecting the environment.

The vision of the program is for our domestic oil resource to reach its full potential in contributing to the Nation's national energy security, economic growth, environmental quality and science and technology leadership. The United States remains the world leader in oil technologies; advanced U.S. technologies are sold and use worldwide. A customer-driven, public-private partnership is recognized as a key contributor to the development of technologies, regulatory streamlining, and policies that support increased oil supplies.

Extensive stakeholder involvement in the development and ongoing assessment of coordinated oil programs is consistent with requirements of the Government Performance and Results Act (GPRA) of 1993. The purpose of the Act is to reduce waste and inefficiency and increase customer satisfaction in Federal programs.

DOE's RD&D acts as a catalyst for increasing domestic oil production. In turn, this supports the reliability and affordability of energy supplies and the stability of energy markets, providing an essential foundation for U.S. economic strength and the global economy. By offsetting some increased oil imports, domestic production also enhances U.S. energy security, contributes positively to the U.S. balance of trade, increases economic activity and creates high-paying jobs.

Because reliable domestic energy supplies are vital to the Nation's economy, this program conducts a range of projects designed to enhance the efficiency and environmental quality of domestic oil operations. These R&D programs are conducted in partnership with universities, State and local governments, industry and other organizations. Private sector participation is emphasized through industry cost-sharing with individual companies and consortium to ensure relevance and to facilitate the transfer of technology to the private

I. **Mission Supporting Goals and Objectives:** OIL TECHNOLOGY (Cont'd)

sector while leveraging Federal R&D investment. The degree of industry cost-sharing varies with the technology and industry involvement. The amount is generally lower at the front end where the technical risk is the highest and larger at the more advanced stages, such as in the demonstration programs.

The sections contained in this program are (1) exploration and production supporting research which consists of reservoir life extension (RLE), advanced drilling, completion, and stimulation systems (ADCS), advanced diagnostics and imaging systems (ADIS), planning and analysis efforts and technology transfer, (2) recovery field demonstrations, (3) effective environmental protection (EEP) research and (4) emerging processing technology applications (EPTA) research. Oil Technology implementation activities are managed by DOE's National Petroleum Technology Office (NPTO) located in Tulsa.

The RLE work focuses on coordinating oil technology activities in research, development, and demonstration of advanced technologies for extraction of hydrocarbons from known (discovered) oil reservoirs. These activities provide improved technology and/or more efficient methods to recover more of the 351 billion barrels of discovered but unproduced domestic oil resource. The goals are to increase recovery of oil from Federal lands, to conduct research to develop and demonstrate tools and methodologies that permit oil operators to recover hydrocarbons from known reservoirs not producible by current technology, and support university research in extraction technologies and recovery-process modeling to ensure a supply of well-trained workers. The objective is to develop scientific breakthroughs which are applicable to the industry and that benefit the Nation's economy and protect our environmental heritage. Fundamental and applied geotechnical studies and the industry driven Natural Gas and Oil Recovery Technology Partnership efforts will also be continued.

The ADCS work focuses on developing tools and techniques to drill, complete and stimulate oil wells to produce the 40 billion barrels of oil EIA estimates will be produced domestically by the year 2015. Program goals are to assist industry with developing a balanced portfolio of ADCS technologies that will match the diverse geologic formations, develop new technologies that reduce costs increase exploration success, minimize formation damage, minimize potential environmental damage, and improve producibility of wells. Other goals are to develop, demonstrate and deploy new technologies that enhance industry acceptance and use of technologies designed to reduce costs and improve productivity of oil wells and to coordinate and collaborate with industry groups to attain these objectives.

The ADIS work focuses on methods to develop technologies that will improve the success rates and cost efficiencies for finding new fields and developing producing ones. These technologies are required to ensure a longer-term economic supply of domestic oil needed

I. **Mission Supporting Goals and Objectives:** OIL TECHNOLOGY (Cont'd)

to meet usage projections of over 40 billion barrels oil by 2015 (EIA). The activities in this area are important to finding and economically developing the U.S. Geological Survey and Mineral Management Service resource base estimated to be between 60 and 100 billion barrels of undiscovered oil in the United States. Program goals are to conduct research to develop technologies needed for deeper, higher temperature reservoirs, providing U.S. technology leadership worldwide in geoscientific diagnostics and imaging systems, thereby increasing technology exports that contribute to high-paying U.S. jobs. Other objectives are to conduct research to develop and deploy technologies that can provide a refined picture of underground resources and their environments, resulting in fewer dry holes, better usage of natural phenomena (such as fractures), and development of more effective well patterns, which can reduce the overall amount of required drilling fluids and surface damage thus reducing the environmental footprint. Enhancing oil production from Federal lands, by developing technologies that will continue to provide technical, environmental, and economic justification for exploiting these resources, is also an important goal.

The planning and analysis and technology transfer areas support the program by assuring that a strong, continuous dialogue exists with industry and other stakeholders, providing guidance for program planning and evaluation of program results. The technologies are conveyed to industry users through an aggressive technology transfer program. The oil program is a major source of new technology and information for U.S. companies, especially for those that lack technical resources. Effective program planning requires accurate data on and gas resource, supply and utilization trends, industry activities and R&D needs. Legislative, regulatory and policy initiatives in oil supply, environmental and processing must be based on the best available information to support program goals.

Funding for laboratory research and evaluation of past advanced field trials directed to incremental recovery potentials in large, promising Class 1, 2, and 3 reservoirs will continue. Efforts in this program will continue to foster improvement in recovery technology to extend reservoir life, improve diagnosis and imaging of reservoirs, and develop drilling, completion and stimulation technologies to support the Nation's economy by applying what has been learned in the various supporting research and previous field demonstration work. These efforts also recognize the need for oil field activities.

The environmental research activities focus on technologies and practices that reduce the threat to the environment and decrease the cost of effective environmental protection and compliance. The activities in this area are governed by four program elements; risk assessment, regulatory streamlining, technology development, and program planning and analysis. Program goals are to maximize industry recovery of U.S. oil resources by reducing the cost of effective environmental protection. The program works to lower the cost of environmental compliance through a combination of risk assessment, technology development, regulatory streamlining, impact

I. **Mission Supporting Goals and Objectives:** OIL TECHNOLOGY (Cont'd)

analysis, and facilitating dialogue that attempts to achieve consensus among the affected parties on ways to balance the need to develop the Nation's energy resources with the maintenance of our environmental values. In addition, the environmental program's goals are to improve environmental performance, expand the capabilities of State and Federal governments to make more cost-effective, risk-based regulatory decisions promoting sound science and common sense and to improve communication and technology transfer among industry, government, the Native Tribes, and the public toward balancing national energy, economic and environmental objectives.

This oil research program, in partnership with industry and its stakeholders, will maximize recovery of the estimated 350 billion barrels of currently unrecoverable oil and to develop cutting edge processing technologies to better convert this oil into transportation products, develops technologies to minimize waste production and environmental damage and demonstrates the effectiveness of this technology supporting the Nation's energy security and science and technology leadership goals. Science and Technology Leadership is furthered by the core studies in the areas of extraction technologies, thermodynamics, processing, and reservoir characterization. This leadership is also supplemented by teacher training programs, student and faculty internships, as well as a broad program of university research. Minority participation in science is addressed by special initiatives for Historically Black Colleges and Universities and Nation American Tribes.

II. A. **Funding Schedule:** OIL TECHNOLOGY

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Exploration and Production Supporting Research	\$29,107	\$30,635	\$31,546	\$911	3%
Recovery Field Demonstrations	5,454	6,053	7,800	1,747	29%
Effective Environmental Protection	5,337	6,361	10,820	4,459	70%
Emerging Processing Technology Applications	<u>5,286</u>	<u>5,520</u>	<u>0</u>	<u>-5,520</u>	<u>-100%</u>
Total, Oil Technology	<u>\$45,184</u>	<u>\$48,569</u>	<u>\$50,166</u>	<u>\$1,597</u>	<u>3%</u>

II. B. **Laboratory and Facility Funding Schedule:** OIL TECHNOLOGY (Cont'd)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Argonne National Lab (East)	\$255	\$125	\$250	\$125	0%
Brookhaven National Lab	600	715	1,150	435	61%
Idaho National Engineering Lab	423	200	0	-200	0%
Lawrence Berkeley Lab	540	614	350	-264	-43%
Lawrence Livermore National Lab	352	450	500	50	11%
Los Alamos National Laboratory	1,123	250	300	50	20%
Pacific Northwest Laboratory	137	100	0	-100	-100%
Sandia National Laboratories	400	400	500	100	25%
All Other	<u>41,354</u>	<u>45,715</u>	<u>47,116</u>	<u>1,401</u>	<u>3%</u>
Total, Oil Technology	<u>\$45,184</u>	<u>\$48,569</u>	<u>\$50,166</u>	<u>\$1,597</u>	<u>3%</u>

III. **Performance Summary:** OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research	<p>Analysis and Planning</p> <p>Continue technical planning and analysis support. Conduct producibility assessments of major reservoirs, maintain and update the oil resource information base, input and evaluate the data from the Class Program, and continue technical planning and analytical supporting tasks. (\$3,532) (TBD, M&O, UNITAR, CMG)</p>	<p>Analysis and Planning</p> <p>Continue technical planning and analysis support. Conduct producibility assessments of major reservoirs, maintain and update the oil resource information base, input and evaluate the data from the Class Program, and continue technical planning and analytical supporting tasks. (\$3,517) (IOGCC, M&O, Brashear, TU)</p>	<p>Analysis and Planning</p> <p>Continue technical planning and analysis support for implementing and evaluating effective and efficient oil research programs. Conduct producibility assessment of major reservoirs, maintain and update the oil resource information base, enhance and maintain metrics capabilities for the Oil Program, enhance and maintain statistical data, models, and supporting systems for effective planning and continue technical and analytical support tasks. (\$3,700) (IOGCC, TBD)</p>
	Impact/Oversight/Analysis	Impact/Oversight/Analysis	Impact/Oversight/Analysis
	Continue project impact/oversight/analysis efforts. (\$600) (M&O)	Continue project impact/oversight/analysis efforts. (\$600) (M&O)	Continue project impact/oversight/analysis efforts. Support the contractor review workshop for program evaluation. (\$600) (TBD)

III. **Performance Summary:** OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)	<p>Recovery Efficiency Processes</p> <p>Continue wettability studies, foam mechanism research, low-viscosity heavy oil extraction (alkaline), thermal recovery for heavy oil, and advanced recovery technology/emergency aid to independents. Conduct research in advanced extraction and chemical methods which includes formation stimulation. Continue the DNGOI acceleration (CRADA BPX), MEOR-biotechnology research, recovery processes screening, sweep improvement for gas flooding methods and thermal recovery process for light oil. Conduct a round robin with UNITAR. Continue testing of single well MEOR treatments. Continue studies of target Gulf reservoirs, fund awardees from the advanced recovery concepts PRDA. Conduct advanced</p>	<p>Recovery Efficiency Processes</p> <p>Continue reservoir life extension studies such as, foam mechanism research, low-viscosity heavy oil extraction (alkaline), thermal recovery for heavy oil, and advanced recovery technology/concepts for Schrader Bluff. Conduct research in advanced extraction. Complete the DNGOI acceleration (CRADA BPX), continue MEOR-biotechnology research, recovery processes screening, sweep improvement for gas flooding methods and thermal recovery process for light oil. Conduct a round robin with UNITAR. Continue testing of single well MEOR treatments. Complete studies of target Gulf reservoirs, fund the advanced recovery concepts PRDA. Conduct advanced thermal mechanistic studies. (\$6,400)</p>	<p>Recovery Efficiency Processes</p> <p>Continue reservoir life extension studies toward commercialization of the use of foams for the extraction of low viscosity heavy oil and light oil. Continue to advance thermal methods for heavy oil extraction and screen potential heavy oil recovery processes. Continue to enhance thermal methods for light oil recovery through mechanistic studies. Continue to develop MEOR methods to develop surfactant and other oil recovery agents from waste products which helps lower environmental damage from the disposal of these wastes. Continue low cost oil recovery methods using wettability alternations and alkaline-surfactant-polymer (ASP) methods. Continue research to improve the sweep efficiency and</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)	thermal mechanistic studies. (\$6,493) (INEL, LBL/UC, M&O, SUPRI/USC, TBD, Stanford)	(LBL/UC, M&O, SUPRI/USC, NMIMT, NRC, INEL TBD)	recovery efficiency of gas flooding using more environmentally benign chemicals. (\$6,480) (LBL, NMIMT, Stanford, SUPRI, TBD)
	Reservoir Characterization	Reservoir Characterization	Reservoir Characterization
	Continue advanced reservoir characterization, including: advanced microseismic mapping, geomechanical influences on reservoir during depletion/repressurization, and EM process sensing with industry for large producing reservoirs. Development of advanced imaging technologies and algorithms, NMRI and Cat-Scan for quantitative analysis of reservoir rock architecture and fluid distribution. Develop/improve technologies for accurate measurement of two & three phase relative permeabilities in steady and unsteady-state conditions	Continue advanced reservoir imaging and diagnostic systems work including: advanced microseismic mapping, geomechanical influences on reservoir during depletion/repressurization, and EM process sensing with industry for large producing reservoirs. Development of advanced imaging technologies and algorithms, NMRI and Cat-Scan for quantitative analysis of reservoir rock architecture and fluid distribution. Develop/improve technologies for accurate measurement of multiphase relative permeabilities in steady	Continue advanced reservoir diagnostic and imaging systems work including, advanced microseismic mapping, geomechanical influences on reservoir during depletion/repressurization, and EM process sensing with industry for large producing reservoirs to optimize oil recovery while minimizing environmental risks. Continue development of advanced imaging technologies and algorithms, NMRI and Cat- Scan for quantitative analysis of reservoir rock architecture and fluid distribution. Develop technologies for accurate

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Exploration and Production Supporting Research (Cont'd)	<p>under broad temperature and pressure conditions, and investigate influences of rock, fluid and rock-fluid interaction on these critical parameters. Develop integrated geological, geophysical and engineering methods for predicting areal distribution of reservoir architecture and Mobil oil flow patterns, using methodologies for upscaling to the interwell scale for infill drilling and EOR/IOR. Continue fundamental geoscience analysis of naturally fractured reservoirs and geoscience measurements. Continue the work on an extensive outcrop and subsurface database over the Gypsy field site. Univ. of KS will continue the Petroleum Atlas Project. Continue geoscience data preservation. (\$6,631) (LANL, LLNL, SNL, AGI, RERI, M&O, Fort Valley, Univ, of KS)</p>	<p>and unsteady state conditions under broad temperature and pressure conditions, and investigate influences of rock-fluid interaction on these critical parameters. Develop integrated geological, geophysical and engineering methods for predicting areal and vertical distribution of reservoir architecture and mobile oil flow patterns, using methodologies for upscaling to the interwell scale for infill drilling and EOR/IOR. Continue fundamental geoscience analysis of naturally fractured reservoirs and geoscience measurements and fund awardees from the fundamental geoscience PRDA. Univ. of KS will continue the Petroleum Atlas Project. (\$6,300) (LANL, LLNL, SNL, RERI, KU, TBD, M&O)</p>	<p>measurement of multiphase relative permeabilities in steady and unsteady-state conditions under broad temperature and pressure conditions, and investigate influences of rock-fluid interactions on these critical parameters. Develop integrated geological, geophysical and engineering data and methods for predicting areal and vertical distribution of reservoir architecture and mobile oil flow patterns, using methodologies for upscaling to the interwell scale for infill drilling and EOR/IOR, thus minimizing numbers of infill wells, surface footprints and associated environmental effects. Continue fundamental geoscience involving geoscience/engineering reservoir characterization for a variety of reservoir types and depositional environments to optimize field development and management</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)			while minimizing environmental exposure. Investigate reservoir pressure/gas saturations, wettability and matrix block size on spontaneous imbibition in fractured reservoirs for improved oil recovery. (\$6,050) (LANL, LLNL, SNL, RERI, U of KA, TBD, Univ. of Tulsa)
	Technology Transfer	Technology Transfer	Technology Transfer
	Continue outreach to unaffiliated stakeholder groups; transfer of results from Class Demonstration Projects; continue teacher training programs; increase minority opportunities for summer students; continue program exhibits; improve efficiency of publication, software dissemination (\$890). Assist PTTC implement Phase 2 tech transfer activities (\$1,687). These efforts will meet the needs	Continue outreach to stakeholder groups; transfer results from Class Demonstration Projects to extend reservoir life; continue teacher training programs; increase minority opportunities for summer students; continue program exhibits; improve efficiency of publication, software dissemination (\$1,023). Assist PTTC to implement Phase 2 tech transfer activities (\$2,100). These efforts	Continue technology outreach by supporting regional workshops providing complete packages of applicable results from Class Demonstration and other projects to assist oil producers in extending reservoir life in an environmentally acceptable manner; improve efficiency and coverage in electronic and hardcopy dissemination of publications and software; increase participation of

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)	of major and independent producer, support service industry elements, academic researchers, technical associations, and the public sector. (Total \$2,577) (M&O, PTTC, UNITAR, SPE)	will meet the needs of major and independent producer, support service industry elements, academic researchers, technical associations, and the public sector. (Total \$3,123) (M&O, PTTC, UNITAR, SPE, Univ. of Houston)	Native American and HBCU students in expanded summer intern program of career- enhancing petroleum science research projects, continue teacher training program for elementary/secondary petroleum energy education; expand schedule of exhibits at professional meetings and upgrade display materials and equipment. These efforts will improve the ability to meet the technological and environmental needs of major and independent producers, support service industry elements, academic researchers, technical associations, and the public sector. (Total \$3,005) (TBD, PTTC, UNITAR, SPE, Univ. Of Houston)

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)	<p>Exploration and Drilling</p> <p>Conduct basin analysis in Central Mid Continent in Gulf Coast, and Black Mesa Basin in accordance with DNGOI. Increase activities with Native American tribal areas, reduce risk of prospects and increase the success ration for finding undiscovered and bypassed oil. Improve horizontal well, slimhole drilling and production tools research. Support research in advanced exploration technology. (\$3,063) (TBD, Standford, M&O, ANL, Alabama, Old Dominion, Osage Tribe, Univ. CEA, Univ. DEA, WV/JIP)</p>	<p>Exploration and Drilling</p> <p>Complete basin analysis in Central Mid Continent in accordance with DNGOI. Continue activities in Native American tribal areas, reduce risk and increase success in finding undiscovered and bypassed oil. Using advanced drilling completion and stimulation systems, improve horizontal well, slimhole drilling and production tools research. Support research in advanced exploration technology by advanced imaging and diagnostic systems and fund awardees in the advanced drilling concepts PRDA. (\$3,908) (TBD, Standford, Alabama, OERB, WU, BIA, TU, USGS)</p>	<p>Advanced Drilling, Completion & Surface Facilities; Risk Based Decision Making Tools:</p> <p>Continue to develop comprehensive detailed lithostratigraphic/climatic models for the development of both clastic and carbonate sedimentary basins by universities, national labs, and industry. Continue the analysis of the Hopi Black Mesa Basin using advanced exploration tools and test new ideas in the next high priority basin. Continue the advanced research and high temperature/high pressure experimentation on theology and cuttings transport in energized fluids (gas assisted, foam, mist, etc.) In horizontal and small diameter wellbores using the DOE Flow Loop. Continue research on the more environmentally benign three phase separation technology development for reduced cost and</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)			improved efficiency on offshore platforms and onshore fields. Continue to upgrade and expand the current DOE suite of risk based decision-making tools used most by industry. Continue work to increase the recovery efficiency from American Tribal lands in an environmentally and culturally sound manner. (\$3,980) (TBD, Univ. of Tulsa, LSU, WU, USGS, ANL, Univ. of Alabama, Osage Tribe, Hopi)

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Exploration and Production Supporting Research (Cont'd)	<p>Multi NL/Industry Partnership & NL Supporting R&D</p> <p>Develop/adapt/transfer technology that advances understanding of the characteristics and producibility from oil reservoirs, optimize the performance of production tools and processes, and improves reservoir management resulting in higher oil recovery; through leveraging industrial, oil program and other public funds. Integrate high performance National Lab computing technology to increase reservoir productivity in areas of reservoir characterization, production prediction and management. (\$5,416) (LANL, NL-TBD)</p>	<p>Multi NL/Industry Partnership & NL Supporting R&D</p> <p>Develop/adapt/transfer technology that advances understanding of the characteristics and producibility from oil reservoirs, optimizes the performance of production tools and processes, and improves reservoir management resulting in higher oil recovery through leveraging of industrial, oil program and other public funds. Integrate high performance National Lab exploration capabilities to address difficult problems such as subsalt imaging, testing of advanced exploration concepts and multiphase flow in subsea pipelines. (\$6,400) (NL-TBD)</p>	<p>Multi NL/Industry Partnership & NL Supporting R&D</p> <p>Continue to adapt and transfer technologies that advance understanding of the characteristics and producibility from oil reservoirs, optimize the performance of production tools and processes, reduce environmental footprint and waste emissions and improve reservoir management resulting in higher oil recovery through leveraging of industrial, oil program and other public funds. Continue to integrate high performance National Lab computational capabilities to address difficult problems such as subsalt imaging, testing of advanced exploration concepts and multiphase flow in subsea pipelines. (\$7,416) (NL-TBD)</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Exploration and Production Supporting Research (Cont'd)	Domestic Kerogen: Conduct research activity related to the domestic Kerogen Value Enhancement Research Project with the objective of commercialization of technology for the recovery of higher value nitrogen compounds from shale oil. (\$500) (METC) Management Support Fund technical and program management support. (\$295)	Domestic Kerogen: No activity. (\$0) Management Support Fund technical and program management support (\$306).	Domestic Kerogen: No activity. (\$0) Management Support Fund technical and program management support. (\$315)
	\$29,107	\$30,635	\$31,546

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Recovery Field Demonstrations	<p>Class 1 (Fluvial Dominated Deltaic):</p> <p>No activity. (\$0)</p> <p>Class 2 (Shallow Shelf Carbonates):</p> <p>No activity. (\$0)</p>	<p>Class 1 (Fluvial Dominated Deltaic):</p> <p>Revisit major reservoir groups by competitively selecting cost-shared projects to extend reservoir life. (\$650) (TBD)</p> <p>Class 2 (Shallow Shelf Carbonates):</p> <p>Revisit major reservoir groups by competitively selecting cost-shared projects to extend reservoir life. (\$686) (TBD)</p>	<p>Class 1 (Fluvial Dominated Deltaic):</p> <p>Extend reservoir life to maximize oil recovery and improve environmental performance from our initial investment by revisiting major reservoir groups to address key production problems identified in previous work. (\$2,350) (TBD)</p> <p>Class 2 (Shallow Shelf Carbonates)</p> <p>Extend reservoir life to maximize oil recovery and improve environmental performance from our initial investment by revisiting major reservoir groups to address key production problems identified in previous work. (\$2,350) (TBD)</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Recovery Field Demonstrations (Cont'd)	<p>Class 3 (Slope Basin Clastic):</p> <p>Near-Term: Complete funding for four competitively selected, cost-shared technology transfer and demonstration projects directed to facilitating timely and broad adoption of improved geological and geophysical measurement, geological/engineering modeling, and extraction technologies to extend the productive life of mature reservoirs that have the potential for significant additional oil recovery (\$2,200). Mid-Term: Continue funding of five competitively selected, cost-shared, field projects directed to demonstrating advanced reservoir decription and extraction technologies that can result in substantial additional oil recovery in a significant number of Class 3 reservoirs (\$2,858). (Total \$5,058) (TBD)</p>	<p>Class 3 (Slope Basin Clastic):</p> <p>Revisit major reservoir groups by competitively selecting cost-shared projects to extend reservoir life. Mid-Term: Complete funding of five competitively selected, cost-shared, field projects directed to demonstrating advanced reservoir decription and extraction technologies that can result in substantial additional oil recovery in a significant number of Class 3 reservoirs. (\$3,956) (M&O, TBD)</p>	<p>Class 3 (Slope Basin Clastic):</p> <p>Extend reservoir life to maximize oil recovery and improve environmental performance from our initial investment by revisiting major reservoir groups to address key production problems identified in previous work. (\$2,362) (TBD)</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Recovery Field Demonstrations (Cont'd)	Increase production from marginal wells: continue reservoir management techniques for marginal wells. Continue cost-shared projects with small operators for innovative technologies to improve production efficiency in marginal wells at risk of abandonment. (Total \$205) (M&O, TBD)	Increase production from marginal wells by conducting reservoir life extension projects such as: continue cost-shared reservoir management techniques for marginal wells (\$350). Continue cost-shared projects with small operators for innovative technologies to improve production efficiency and extend the life of in marginal wells at risk of abandonment (\$350) (Total \$700) (M&O, TBD)	Increase production from marginal wells by conducting reservoir life extension projects such as: continue cost-shared reservoir management techniques for marginal wells (\$330). Continue to focus on production problems identified by small operators of marginal wells at risk of abandonment to extend reservoir life and oil recovery from selected properties. These improvements can come through decreased operating or environmental costs or improved equipment design (\$330). (Total \$660) (TBD)

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Recovery Field Demonstrations (Cont'd)	Continue activities at the Rocky Mountain Oilfield Test Center to demonstrate, test and evaluate new technologies and equipment, and provide training opportunities. Example project areas include steamflood and chemical injection processes reservoir simulation studies, seismic applications, and technology for treating production wastes. (\$135) (NPR)	No activity. (\$0)	No activity. (\$0)
	Fund technical and program management support. (\$56)	Fund technical and program management support. (\$61)	Fund technical and program management support. (\$78)
	\$5,454	\$6,053	\$7,800

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Effective Environmental Protection	<p>Program Planning and Analysis:</p> <p>Continue analysis of industry and environmental trends and maintain performance measure data for program planning and technology transfer. Conduct cooperative efforts with industry, states, federal agencies and others to promote environmentally sound oil resource recovery and resolve regional environmental constraints to sustained oil production and efficient oil resource recovery. Perform legislative and regulatory impact analysis related to oil environmental issues. (Total \$800) (M&O, TBD, SPE, IPAMS, ANL, ICF, IOGCC)</p>	<p>Program Planning and Analysis:</p> <p>Continue analysis of industry and environmental trends and maintain performance measure data for program planning and technology transfer. Conduct cooperative efforts with industry, states, federal agencies and others to promote effective environmental protection and resolve regional environmental constraints to sustained oil production and efficient oil resource recovery. Perform legislative and regulatory impact analysis related to oil environmental issues. (\$800) (LBL, ANL, ICF, ALO, TBD)</p>	<p>Program Planning and Analysis:</p> <p>Continue analysis of industry environmental trends and maintain performance measure data for program planning and technology transfer. Continue to enhance cooperative efforts with industry, states, federal agencies and others to promote effective environmental protection and resolve regional environmental constraints to sustained oil production and efficient oil resource recovery. Coordinate with EPA and other Federal agencies to provide energy and economic analyses for longer term regulatory initiatives. Continue to perform legislative and regulatory impact analysis related to oil environmental issues. (\$825) (ANL/TBD, SPE/IPEC, TBD)</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Effective Environmental Protection (Cont'd)	<p>Streamline State/Tribal/Federal Regulations:</p> <p>Continue a cooperative effort with the states, tribes, and Federal agencies to streamline environmental regulations and regulatory processes consistent with DNGOI objectives to simplify regulations without compromising environmental protection. (\$750) (IOGCC, M&O, TBD, IPAMS, BEG)</p>	<p>Streamline State/Tribal/Federal Regulations:</p> <p>Continue a cooperative effort with the states, tribes, and Federal agencies to streamline environmental regulations and regulatory processes consistent with DNGOI objectives to simplify regulations without compromising environmental protection. Implement an on-line expert environmental and electronic reporting system to streamline permitting and to reduce costs to producers and regulators. (\$1,075) (IOGCC, M&O, EPA, TBD)</p>	<p>Streamline State/Tribal/Federal Regulations:</p> <p>Consistent with stakeholder needs, continue and enhance cooperative efforts with the states, tribes, and Federal agencies to streamline environmental regulations and regulatory processes to simplify regulations without compromising environmental protection. Enhance on-line expert environmental reporting and permitting systems to reduce costs to producers and regulators (\$1,300). Generate independent quality scientific data to help implement national policy in streamlining and improving existing regulations and laws (\$1,000). (Total \$2,300) (IOGCC, ANL, TBD)</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Effective Environmental Protection (Cont'd)	<p>Risk Assessment:</p> <p>Continue research to assess and mitigate environmental risks posed by oil exploration and production. Continue research to assess and mitigate risks posed to groundwater from injection for disposal and enhanced oil recovery. Expand assistance to States with research, analysis, and improved data management to support risk-based regulatory decisions related to Class II injection well area of review requirements, consistent with DNGOI objectives of streamlining and improving environmental regulations. (\$3,039) (GWPC, M&O, LLNL, KS CORP COM, OK. CORP COM, INEL, OSAGE, VIC, BNL SMRI, TX RAILROAD COM.)</p>	<p>Risk Assessment:</p> <p>Continue research to assess and mitigate environmental risks posed by oil exploration and production including risks posed by injection for disposal and enhanced oil recovery, hydrocarbon or produced water spills, air emissions from exploration and production facilities, and management of oil field wastes. Continue assistance to States with research, analysis, and improved data management to support risk-based regulatory decisions, consistent with the objectives of streamlining and improving environmental regulations. Provide credible scientific data for decision-making. (\$3,461) (GWPC, LLNL, TBD, Osage, NL-TBD, M&O)</p>	<p>Risk Assessment:</p> <p>Continue to provide credible scientific data for regulatory decision making. Continue cooperative efforts with regulatory and industry groups to establish environmentally acceptable end-points. Continue research to assess and mitigate environmental risks posed by exploration and production, including risks posed by injection for disposal and enhanced oil recovery, hydrocarbon or produced water spills, air emissions and management of oil field wastes. Continue support for development of compatible data management systems between state and Federal agencies. Continue assistance to States with research, analysis, and improved data management to support risk-based regulatory decisions consistent with</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Effective Environmental Protection (Cont'd)			stakeholder's objectives of streamlining and improving environmental regulations (\$2,760). Work with industry, states, and EPA to conduct research to help EPA make decisions based on sound science in the area of particulate matter emissions. Serve as a neutral third party between Federal and state regulators and the petroleum industry to develop scientific information on the environmental and health risks of pollutants emitted by the petroleum industry (\$1,500) (Total \$4,260) (GWPC/TBD, Natl. Labs, BNL, TBD/SNL/BEG, PERF, TBD)

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Effective Environmental Protection (Cont'd)	<p>Technology Development and Produced Water Research:</p> <p>Continue research to develop and field test more cost-effective produced water, produced sand, and other environmental compliance technologies including the application of advanced research at the national laboratories. (\$693) (TBD, OERB, M&O, EFX, WESTPORT)</p> <p>Fund technical and program management support. (\$55)</p> <p>\$5,337</p>	<p>Technology Development:</p> <p>Continue research to develop and field test more cost-effective environmental compliance technologies in the areas of produced water treatment, soil remediation, air emissions control, and oil field waste management. (\$962) (BNL, TBD, ARCO, M&O)</p> <p>Fund technical and program management support (\$63).</p> <p>\$6,361</p>	<p>Technology Enhancement and Field Demonstration:</p> <p>Continue to develop and field test more cost-effective environmental compliance technologies in the areas of produced water treatment, remediation, air emissions control and monitoring, and oil field waste management and disposal (\$1,451). Identify various pollutants present in petroleum and develop technology to prevent their formation. In keeping with PCAST recommendations, perform research to make fuels that have fewer emissions affecting global climate change (\$1,876) (Total \$3,327) (TBD, Natl Labs, ORNL, INEL, BNL, OERB)</p> <p>Fund technical and program management support. (\$108)</p> <p>\$10,820</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Emerging Processing Technology Applications	<p>Pollution Prevention</p> <p>Continue to develop fundamental chemical and thermodynamic data focusing on heavy crude oil and residue components to facilitate their upgrading in an environmentally efficient manner. Continue basic and applied research on cracking and coking to improve the efficiency of refineries and increase yields of transportation fuels. Technology and science-based information accepted by all parties will be developed to permit enhanced cost-effective and risk-based programs to progress beyond command and control. Work will also be conducted to identify the various pollutants and technology developed to prevent their formation. Continue research to improve upgrading and overcome environmental barriers with emphasis on West Coast heavy oils. (\$3,829) (BNL, M&O, Natl Lab)</p>	<p>Pollution Prevention</p> <p>Continue to obtain thermodynamic, chemical, and physical data on heavy crude oil and residue components, improve upgrading, and overcome environmental barriers, especially on West Coast heavy oils. Continue to research cracking and coking phenomena to improve upgrading and refining efficiencies and increase yields of transportation fuels in an environmentally efficient manner. Continue to provide fundamental science, accepted by all parties, to support development of efficient environmental regulations that progress beyond command and control. Work will also be conducted to identify various pollutants and technology will be developed to prevent their formation. (\$3,898) (ORNL, LBL, BNL, SNL, M&O, Nat. Lab, TBD)</p>	<p>The majority of this subprogram has been combined with Effective Environmental Protection above. The process thermodynamics/chemistry portion of the subprogram has been discontinued because of uncertainty about its value to the nation and the appropriate Federal role in this effort.</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Emerging Processing Technology Applications (Cont'd)	<p>Environmental Compliance</p> <p>Continue to assist the petroleum industry to improve environmental protection, and change crude oil, product specifications and quality to meet environmental constraints. Studies will be concerned with environmental compliance dealing with remediation, wastewater treatment, waste disposal and air emissions. Work will be performed with the regulators and industrial organizations to expedite installation of pollution prevention processes in the refineries. Many of these programs are to support goals consistent with DNGOI 6.3 and 6.5 in support of a beneficial and viable U.S. refining industry. (\$803) (M&O, PERF, Nat. Labs, LBL, PNL)</p>	<p>Science for Environmental Protection</p> <p>Continue to provide fundamental science to assist the petroleum industry to improve environmental protection, and change crude oil, product specifications and quality to meet environmental constraints. Studies will be concerned with environmental chemistry and physics associated with remediation, wastewater treatment, waste disposal and air emissions. Work will be coordinated and performed with the regulators and industrial organizations to expedite implementation of pollution prevention processes in the refineries. Many of these programs are to support goals consistent with DNGOI 6.3 and 6.5 in support of a beneficial and viable U.S. refining industry. (\$952) (M&O, PERF, LBL, Natl Labs)</p>	<p>The majority of this subprogram has been combined with Effective Environmental Protection above. The process thermodynamics/chemistry portion of the subprogram has been discontinued because of uncertainty about its value to the nation and the appropriate Federal role in this effort.</p>

III. **Performance Summary**: OIL TECHNOLOGY (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Emerging Processing Technology Applications (Cont'd)	<p>Upgrading Tech Development</p> <p>Continue cooperative research programs with the national laboratories and industrial groups will also be conducted in support of the above overall environmental efforts and technology development including an emphasis on biotechnology initiatives to remove S, N and heavy metals from crude oil. (\$600) (ANL, M&O, Nat. Labs, LLNL)</p> <p>Fund technical and program management support. (\$54)</p> <p>\$5,286</p>	<p>Upgrading Research</p> <p>Continue to study fundamental chemistry and physics thru cooperative research programs with the national laboratories and industrial groups in support of the above overall environmental efforts in upgrading very heavy crude oil before it is refined. Emphasis will be placed on biotechnology to remove S, N and heavy metals from crude oil. (\$615) (ANL, M&O/TBD, Nat. Labs, INEL)</p> <p>Fund technical and program management support. (\$55)</p> <p>\$5,520</p>	<p>The majority of this subprogram has been combined with Effective Environmental Protection above. The process thermodynamics/chemistry portion of the subprogram has been discontinued because of uncertainty about its value to the nation and the appropriate Federal role in this effort.</p> <p>No activity. (\$0)</p> <p>\$0</p>
Oil Technology, Total	\$45,184	\$48,569	\$50,166

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PROGRAM DIRECTION AND MANAGEMENT SUPPORT

I. **Mission Supporting Goals and Objectives:**

This activity provides funding for salaries, benefits and overhead expenses for management of the Fossil Energy program at Headquarters, the Federal Energy Technology Center, and the National Petroleum Technology Office. The Headquarters staff is responsible for overall direction of the programs that include implementing DOE policy, communicating guidance consistent with that policy to the FE field offices, establishing program objectives, developing program plans and evaluating alternative program strategies, developing and defending budget requests to the Office of Management and Budget and to Congress, reviewing procurement plans, monitoring work progress, and approving revisions in work plans as required to attain program goals. The Federal Energy Technology Center and project office perform the day-to-day project management functions of assigned programmatic areas that include monitoring Fossil Energy contracts and National Laboratory activities, developing project budgets, implementing procurement plans, and other program and site support activities necessary to achieve program objectives.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Headquarters Program Direction					
Salaries and Benefits	\$9,175	\$9,240	\$9,282	\$42	0%
Travel	420	450	\$470	\$20	4%
Contract Services	<u>4,801</u>	<u>4,969</u>	<u>5,347</u>	<u>\$378</u>	<u>8%</u>
Subtotal, Headquarters Program Direction	14,396	14,659	15,099	\$440	3%

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Field Program Direction					
Salaries and Benefits	27,020	25,674	25,830	156	1%
Travel	966	1,425	1,344	-81	-6%
Contract Services	<u>26,328</u>	<u>25,008</u>	<u>24,758</u>	<u>-250</u>	<u>-1%</u>
Subtotal, Field Program Direction	<u>54,314</u>	<u>52,107</u>	<u>51,932</u>	<u>-175</u>	<u>0%</u>
Total, Program Direction and Management Support	<u>\$68,710</u>	<u>\$66,766</u>	<u>\$67,031</u>	<u>\$265</u>	<u>0%</u>

II. B. **Laboratory and Facility Funding Schedule:** PROGRAM DIRECTION AND MANAGEMENT SUPPORT

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
National Petroleum Technology Office	\$3,317	\$3,373	\$3,782	\$409	12%
Federal Energy Technology Center	50,997	48,734	48,150	-584	-1%
All Other	<u>14,396</u>	<u>14,659</u>	<u>15,099</u>	<u>440</u>	<u>3%</u>
Total, Program Direction and Management Support	<u>\$68,710</u>	<u>\$66,766</u>	<u>\$67,031</u>	<u>\$265</u>	<u>0%</u>

III. **Performance Summary**: PROGRAM DIRECTION AND MANAGEMENT SUPPORT

Activity	FY 1997	FY 1998	FY 1999
Headquarters Program Direction - Salaries and Benefits	Provide funds for 97 FTEs at Headquarters. This staff implements and communicates policy to the FETC, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans; and monitors work progress. (\$9,175)	Provide funds for 95 FTEs at Headquarters. This staff implements and communicates policy to the FETC, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans; and monitors work progress. (\$9,240)	Provide funds for 95 FTE's at Headquarters. This staff implements and communicates policy to the ETC's, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans; and monitors work progress. (\$9,582)
	\$9,175	\$9,240	\$9,582
Travel	Provide funds for travel in support of the activities stated above. Both domestic and international travel are conducted. (\$420)	Provide funds for travel in support of the activities stated above. Both domestic and international travel are conducted. (\$450)	Provide funds for travel in support of the activities stated above. Both domestic and international travel are conducted. (\$470)
	\$420	\$450	\$470
Headquarters Program Direction - Contract Services	Provide for contractual services that are generic to the entire FE program. Included are items such as computer services, technical and management support services (\$652). Provide for E-mail and LAN requirements (\$503). (Total \$1,155) (TBD)	Provide for contractual services that are generic to the entire FE program. Included are items such as computer services, technical and management support services (\$998). Provide for E-mail and LAN requirements (\$348). (Total \$1,346) (TBD)	Provide for contractual services that are generic to the entire FE program. Included are items such as computer services, technical and management support services (\$1,000). Provide for E-mail and LAN requirements (\$350). (Total \$1,350) (TBD)

III. **Performance Summary**: PROGRAM DIRECTION AND MANAGEMENT SUPPORT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters Program Direction (Cont'd) - Contract Services	<p>Fund SBIR in the amount of \$5,718 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund the Small Business Technology Transfer (STTR) in the amount of \$343 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund AD for direct support of computer timesharing/housekeeping (\$298). Fund AD for workstation support for LAN (\$241). (Total \$539)</p> <p>Provide for printing services. (\$160) (TIC)</p> <p>No activity. (\$0)</p> <p>Provide working capital fund. (\$2,947)</p>	<p>Fund SBIR in the amount of \$6,036 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund the Small Business Technology Transfer (STTR) in the amount of \$362 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund AD for direct support of computer timesharing/housekeeping (\$199). Fund AD for workstation support for LAN (\$199). (Total \$398)</p> <p>Provide for printing services. (\$130) (TIC)</p> <p>No activity. (\$0)</p> <p>Provide working capital fund. (\$3,095)</p>	<p>Fund SBIR in the amount of \$6,607 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund the Small Business Technology Transfer (STTR) in the amount of \$398 from prior year and/or various R&D program funds within the Fossil Energy R&D account. (\$0)</p> <p>Fund AD for direct support of computer timesharing/housekeeping (\$235). Fund AD for workstation support for LAN (\$200). (Total \$435)</p> <p>Provide for printing services. (\$30) (TIC)</p> <p>Upgrade electronic records management systems. (\$100)</p> <p>Provide working capital fund. (\$3,432)</p>
	\$4,801	\$4,969	\$5,347

III. **Performance Summary**: PROGRAM DIRECTION AND MANAGEMENT SUPPORT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Headquarters Program Direction, Subtotal	\$14,396	\$14,659	\$15,099
ETC Program Direction Salaries and Benefits	Provide funds for FETC and NPTO indirect staff of 346 (FETC - 323; NPTO - 23) FTEs. Activities of the staff include contract and lab monitoring, development and maintenance of project, budget and procurement plans, and other activities related to program and site support (FETC - \$25,331, NPTO - \$1,689) (Total \$27,020)	Provide funds for FETC and NPTO indirect staff of 340 (FETC - 317; NPTO - 23) FTEs. Activities of the staff include contract and lab monitoring, development and maintenance of project, budget and procurement plans, and other activities related to program and site support (FETC - \$24,000, NPTO - \$1,674) (Total \$25,674)	Provide funds for FETC and NPTO indirect staff of 340 (FETC - 317; NPTO - 23) FTEs. Activities of the staff include contract and lab monitoring, development and maintenance of project, budget and procurement plans, and other activities related to program and site support (FETC - \$23,520, NPTO - \$2,310) (Total \$25,830)
	\$27,020	\$25,674	\$25,830
Travel	Provide funds for travel in support of the above activities in the attainment of program goals, both on the domestic front and abroad. (FETC - \$708, NPTO - \$258) (Total \$966)	Provide funds for travel in support of the above activities in the attainment of program goals, both on the domestic front and abroad. (FETC - \$1,203, NPTO - \$222) (Total \$1,425)	Provide funds for travel in support of the above activities in the attainment of program goals, both on the domestic front and abroad. (FETC - \$1,083, NPTO - \$261) (Total \$1,344)
	\$966	\$1,425	\$1,344

III. **Performance Summary**: PROGRAM DIRECTION AND MANAGEMENT SUPPORT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Contract Services	Provide substantial funding of facility operations, maintenance, finance, AOSS support, administrative, management and technical support. (FETC - \$24,958, NPTO - \$1,370) (Total \$26,328)	Provide substantial funding of facility operations, maintenance, finance, AOSS support, administrative, management and technical support. (FETC - \$23,531, NPTO - \$1,477) (Total \$21,008)	Provide substantial funding of facility operations, maintenance, finance, AOSS support, administrative, management and technical support. (FETC - \$23,547, NPTO - \$1,211) (Total \$24,758)
	\$26,328	\$25,008	\$24,758
Field Program Direction, Subtotal	\$54,314	\$52,107	\$51,932
Program Direction and Management Support, Total	\$68,710	\$66,766	\$67,031

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PLANT AND CAPITAL EQUIPMENT

I. **Mission Supporting Goals and Objectives:**

No funding is requested for capital equipment purchases. Any such needs will be funded within project operating costs, subject to Congressional reprogramming guidelines.

Funding for general plant projects at the Federal Energy Technology Center (FETC) sites and at the National Petroleum Technology Office (NPTO) is requested. General plant projects include repairs, improvements, alterations and additions that are essential to the safe, environmentally acceptable and efficient operations of the FETC sites and NPTO.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Construction	<u>\$2,000</u>	<u>\$2,532</u>	<u>\$2,600</u>	<u>\$68</u>	<u>3%</u>
Total, Plant and Capital Equipment	<u>\$2,000</u>	<u>\$2,532</u>	<u>\$2,600</u>	<u>\$68</u>	<u>3%</u>

II. B. **Laboratory and Facility Funding Schedule**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
All Other	<u>\$2,000</u>	<u>\$2,532</u>	<u>\$2,600</u>	<u>\$68</u>	<u>3%</u>
Total, Plant and Capital Equipment	<u>\$2,000</u>	<u>\$2,532</u>	<u>\$2,600</u>	<u>\$68</u>	<u>3%</u>

III. **Performance Summary:** PLANT AND CAPITAL EQUIPMENT

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Construction	Provide General Plant Projects (GPP) at the FETC and NPTO. (\$2,000)	Provide for General Plant Projects (GPP) at the FETC and NPTO. (\$2,532)	Provide for General Plant Projects (GPP) at the FETC and NPTO. (2,600)
	\$2,000	\$2,532	\$2,600
Plant and Capital Equipment, Total	\$2,000	\$2,532	\$2,600

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

FOSSIL ENERGY ENVIRONMENTAL RESTORATION

I. **Mission Supporting Goals and Objectives:**

The objectives of the Fossil Energy (FE) Environmental Restoration activities are to ensure protection of workers, the public, and the environment in performing the mission of the Federal Energy Technology Centers (FETC) at Morgantown (MGN), West Virginia and Pittsburgh (PGH), Pennsylvania sites and the Albany Research Center (ARC) in Albany, Oregon. Activities include those necessary to protect workers and the public from exposure to hazardous conditions and materials (e.g., fires, carcinogens, asbestos, lead, etc.,) and to achieve compliance with Federal, state and local safety and health requirements. Activities also include environmental protection, and cleanup activities on-site, and at several former off-site research and development locations. DOE has received a Notice of Violation from the State of Wyoming requiring cleanup of the Rock Springs and Hoe Creek sites. EPA and the State of Washington hold DOE partially liable for cleanup of the Western Processing Superfund Site which received wastes from a former solvent refined coal liquefaction pilot plant (Ft. Lewis). Soil and groundwater remediation will be required by the State of Alabama for a former liquefaction operations facility. Groundwater and soil monitoring/remediation is also required at the FETC and ARC sites to ensure compliance with Federal, state and local requirements.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
CERCLA Remedial Actions	\$6,772	\$4,119	\$3,525	\$-594	-14%
RCRA Remedial Actions	3,801	4,923	2,423	-2,500	-51%
Other ES&H Actions	<u>2,481</u>	<u>3,893</u>	<u>5,052</u>	<u>1,159</u>	<u>30%</u>
Total, Fossil Energy Environmental Restoration	<u>\$13,054</u>	<u>\$12,935</u>	<u>\$11,000</u>	<u>\$-1,935</u>	<u>-15%</u>

I. B. **Laboratory and Facility Funding Schedule:** FOSSIL ENERGY ENVIRONMENTAL RESTORATION

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
All Other	<u>\$13,054</u>	<u>\$12,935</u>	<u>\$11,000</u>	<u>\$-1,935</u>	<u>-15%</u>
Total, Fossil Energy Environmental Restoration	<u>\$13,054</u>	<u>\$12,935</u>	<u>\$11,000</u>	<u>\$-1,935</u>	<u>-15%</u>

III. **Performance Summary:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
CERCLA Remedial Actions	Continue cleanup of Rock Springs sites. (\$1,783) (Army Corp of Engineers)	Continue cleanup of Rock Springs sites. (\$634) (Army Corp of Engineers)	Continue cleanup of Rock Springs sites. (\$750) (Army Corps of Engineers)
	Continue cleanup of Hoe Creek site. (\$1,335) (TBD)	Continue cleanup of Hoe Creek site. (\$959) (TBD)	Continue cleanup of Hoe Creek site. (\$800) (Army Corps of Engineers)
	Cleanup of IGT site. (\$27) (TBD)	No activity. (\$0)	No activity. (\$0)
	No activity. (\$0)	Initiate Hannah Site revegetation. (\$22)	Continue Hannah Site revegetation. (\$50)
	No activity. (\$0)	Perform preliminary assessment/site investigations of inactive projects. (\$247)	Continue preliminary assessment/site investigations of FETC inactive projects. (\$425)
	Complete FETC ES&H risk assessment. (\$100) (TBD)	No activity. (\$0)	Continue with Phase II FETC risk assessment documentation. (\$60)
	Continue cleanup of soil and groundwater at former FETC liquefaction sites. (\$2,923) (TBD)	Continue cleanup of soil and groundwater at former FETC liquefaction sites. (\$2,061) (TBD)	Continue cleanup of soil and groundwater at former FETC liquefaction sites. (\$530) (TBD)

III. **Performance Summary:** FOSSIL ENERGY ENVIRONMENTAL RESTORATION (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
CERCLA Remedial Actions (Cont'd)	Continue Magnetohydrodynamics (MHD) closeout and cleanup ES&H actions. (\$504) (TBD)	Complete Magnetohydrodynamics (MHD) closeout and cleanup ES&H actions. (\$103) (TBD)	No activity. (\$0)
	Complete funding of Indiana hazardous waste cleanup. (\$100) (TBD)	No activity. (\$0)	No activity. (\$0)
	No activity. (\$0)	No activity. (\$0)	Perform onsite CERCLA-type remediation assessments at FETC. (\$50) (TBD)
	No activity. (\$0)	Fund Western Processing remediation activities. (\$93) (TBD)	Implement CERCLA PRP Response Activities (e.g. Western Processing). (\$860) (TBD)
	\$6,772	\$4,119	\$3,525

III. **Performance Summary:** FOSSIL ENERGY ENVIRONMENTAL RESTORATION (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
RCRA Remedial Actions	Continue FETC remediation activities such as acid mine drainage; stormwater line consolidation and drainage remediation; contaminated sewer line removal; lead and asbestos abatement and investigation of abandoned pipeline; develop a toxic chemical management system; and predisposal waste characterization. (\$1,540) (TBD)	Continue FETC on-site remediation activities such as acid mine drainage; stormwater line consolidation; contaminated sewer line and abandoned pipeline removal; lead and asbestos abatement; PCB removal; develop toxic chemical management system; waste minimization/pollution prevention; characterizing hazardous wastes; reducing hazardous waste generation; monitoring groundwater and air quality; implementing ozone protection program; and updating site RCRA requirements. (\$2,458) (TBD)	Continue FETC on-site remediation activities such as lead and asbestos abatement; underdrain leachate remediation; waste minimization and pollution prevention activities; toxic chemical management program upgrades; hazardous material and waste compliance activities; PCB removal; resolution of fecal coliform in stormwater; improvements in stormwater catch basin; replacement of ozone depleting substances; and closeout of inactive waste ponds. (\$1,723) (TBD)
	Waste minimization/pollution prevention activities at FETC.(\$80) (TBD)	Included in FETC on-site characterization. (\$0)	Included in FETC on-site characterization. (\$0)
	Initiate remediation actions to close NIPER. (\$2,181) (TBD)	Complete remediation actions to close NIPER. (\$2,465) (TBD)	No activity. (\$0)

III. **Performance Summary:** FOSSIL ENERGY ENVIRONMENTAL RESTORATION (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
	No activity. (\$0)	No activity. (\$0)	Initiate RCRA cleanup actions at Albany Research Center including characterizing and resolving chemical and radioactive storage, labeling; handling; and disposal problems. (\$700) (TBD)
	\$3,801	\$4,923	\$2,423
Other ES&H Actions	Continue ES&H activities at the FETC sites and NIPER requiring corrective action and related activities. (\$2,351) (IITRI, TBD)	Continue ES&H activities at the FETC sites requiring corrective action and related activities. (\$3,764) (IITRI, TBD)	Continue ES&H activities at the FETC sites requiring corrective action and related activities including monitoring and surveillance; indoor air quality fixes; resolution of life safety code deficiencies; fire protection compliance actions; ergonomics; training improvements; structural safety fixes; and emergency preparedness upgrades. (\$4,446) (TBD)
	Technical and management support. (\$130)	Technical and management support. (\$129)	Technical and management support. (\$110)

III. **Performance Summary:** FOSSIL ENERGY ENVIRONMENTAL RESTORATION (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Other ES&H Actions (Cont'd)	No activity. (\$0)	No activity. (\$0)	Initiate site-wide safety and health corrective actions at Albany Research Center including training, machine guarding, lockout/tagout, and fume hoods. (\$496) (TBD)
	\$2,481	\$3,893	\$5,052
Fossil Energy Environmental Restoration, Total	\$13,054	\$12,935	\$11,000

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

COOPERATIVE RESEARCH AND DEVELOPMENT

I. **Mission Supporting Goals and Objectives:**

The Cooperative Research and Development program addresses national priority objectives by supporting strategic Fossil Energy research of high merit and relevance to the U.S. market that is selected and funded collaboratively by federal and non-federal parties. It currently supports activities of federal/industry/research institute endeavors and federal/state/industry partnerships. It was originally created in FY 1989 and provided the federal share of support for Jointly Sponsored Research Programs (JSRP) at the Western Research Institute (WRI) and the University of North Dakota Energy and Environmental Research Center (UNDEERC). The research projects under the JSRP at those centers receive at least 50 percent cost sharing from non-federal partners.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Cooperative Research and Development	<u>\$5,432</u>	<u>\$5,840</u>	<u>\$5,836</u>	<u>\$-4</u>	<u>0%</u>
Total, Cooperative Research and Development	<u>\$5,432</u>	<u>\$5,840</u>	<u>\$5,836</u>	<u>\$-4</u>	<u>0%</u>

I. B. **Laboratory and Facility Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
All Other	<u>\$5,432</u>	<u>\$5,840</u>	<u>\$5,836</u>	<u>\$-4</u>	<u>0%</u>
Total, Cooperative Research and Development	<u>\$5,432</u>	<u>\$5,840</u>	<u>\$5,836</u>	<u>\$-4</u>	<u>0%</u>

III. **Performance Summary**: COOPERATIVE RESEARCH AND DEVELOPMENT (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cooperative Research and Development	Provide support for cooperative research programs at WRI (\$2,463) and UNDEERC (\$2,929) which are 50-50 cost-shared with non-federal clients. (\$5,392) (WRI, UNDEERC)	Provide support for cooperative research programs at WRI (\$2,900) and UNDEERC (\$2,900) which are 50-50 cost-shared with non-federal clients. (\$5,800) (WRI, UNDEERC)	Provide support for cooperative research programs at WRI (\$2,898) and UNDEERC (\$2,898) which are 50-50 cost-shared with non-federal clients. (\$5,796) (WRI, UNDEERC)
	Fund technical and program management support. (\$40)	Fund technical and program management support. (\$40)	Fund technical and program management support. (\$40)
	\$5,432	\$5,840	\$5,836
Cooperative Research and Development, Total	\$5,432	\$5,840	\$5,836

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

FUELS PROGRAM

I. **Mission Supporting Goals and Objectives:**

The Office of Fuels Programs (OFP) manages the regulatory review of natural gas imports and exports, exports of electricity, and the construction and operation of electric transmission lines which cross the U.S. international border; and exercises regulatory oversight of the conversion of existing oil and gas-fired powerplants, processes exemptions from the statutory provisions of the Powerplant and Industrial Fuel Use Act of 1978 (FUA), as amended, and processes certifications of alternate fuel capability pursuant to the provisions of the amended FUA. These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping to ensure: the availability of reliable, competitively priced natural gas; that surplus domestic gas supplies can be marketed internationally in a competitive and environmentally sound manner; and that exports of electric energy and the construction of new international electric transmission lines do not adversely impact on the reliability of the U.S. electric power supply system. The program promotes the use of alternate fuels in new baseload electric powerplants; and assumes that international gas and electricity trade occurs in the freest possible marketplace. OFP is an integral part of the Department's efforts to achieve a less regulated energy marketplace. The OFP's activities help deregulate energy markets and reduce international trade barriers, and to create an integrated North American energy market. OFP encourages greater exchange of technical and regulatory information among our trading partners. Through its publications, OFP increases public awareness of energy issues and the advantages of competition in the marketplace.

II. A. **Funding Schedule:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Fuels Program	<u>\$2,188</u>	<u>\$2,173</u>	<u>\$2,173</u>	<u>\$0</u>	<u>0%</u>
Total, Fuels Program	<u>\$2,188</u>	<u>\$2,173</u>	<u>\$2,173</u>	<u>\$0</u>	<u>0%</u>

II. B. **Laboratory and Facility Funding Schedule:** FUELS PROGRAM

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Argonne National Lab (East)	\$50	\$0	\$0	\$0	0%
All Other	<u>2,138</u>	<u>2,173</u>	<u>\$2,173</u>	<u>\$0</u>	<u>0%</u>
Total, Fuels Program	<u>\$2,188</u>	<u>\$2,173</u>	<u>\$2,173</u>	<u>\$0</u>	<u>0%</u>

III. **Performance Summary:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Fuels Program	Modify or rescind 3 conversion orders. Process 50 certifications of coal capability and 3 exemptions. (\$50)	Modify or rescind 3 conversion orders. Process 50 certifications of coal capability and 3 exemptions. (\$50)	Modify or rescind 3 conversion orders. Process 50 certifications of coal capability and 3 exemptions. (\$50)
	Process 200 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Participate in FERC proceedings and international studies. Provide petroleum policy support for ASFE. NEPA compliance activities. (19 FTEs) (\$1,367)	Process 200 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Participate in FERC proceedings and international studies. Provide petroleum policy support for ASFE. NEPA compliance activities. (19 FTEs) (\$1,357)	Process 200 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Participate in FERC proceedings and international studies. Provide petroleum policy support for ASFE. NEPA compliance activities. (19 FTEs) (\$1,357)

III. **Performance Summary**: FUELS PROGRAM (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Fuels Program (Cont'd)	Process 35 electricity export applications and 10 construction permits. Monitor and analyze inter- national and domestic electricity trade. Participate in FERC proceedings. Participate in international studies and trade negotiations. NEPA compliance activities. (\$635) Provide management and administrative support. (\$136)	Process 35 electricity export applications and 10 construction permits. Monitor and analyze inter- national and domestic electricity trade. Participate in FERC proceedings. Participate in international studies and trade negotiations. NEPA compliance activities. (\$630) Provide management and administrative support. (\$136)	Process 35 electricity export applications and 10 construction permits. Monitor and analyze inter- national and domestic electricity trade. Participate in FERC proceedings. Participate in international studies and trade negotiations. NEPA compliance activities. (\$630) Provide management and administrative support. (\$136)
Fuels Program, Total	\$2,188	\$2,173	\$2,173

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

ADVANCED METALLURGICAL PROCESSES

I. **Mission Supporting Goals and Objectives:**

The following mission was transferred from the Bureau of Mines to the Department of Energy in Public Law 104-99 in FY 1996 and currently remains in the DOE:

- The conduct of inquiries, technological investigations, research concerning the extraction, processing, use, and disposal of mineral substances under the mineral and materials science program at the Albany Research Center (ARC) in Oregon.

The mission of the program is to provide stewardship for the Nation's mineral resources by conserving items produced from minerals. The emphasis is on resource conservation solutions to national problems through cost-shared cooperative work. The program addresses the full life cycle of materials production and cost-effective processing of advanced materials to their disposal and recycling. The program seeks to determine the factors that limit service life of materials in industrial, structural, or engineering applications and to provide solutions to service-life problems through new materials technology, to develop and demonstrate technologies that will reduce waste and pollution, to use capabilities and expertise to provide focused solutions to high priority national problems in the mining and processing of coal, and to establish and maintain mutually beneficial partnerships with industry and other agencies to share the costs, tasks, and national benefits of this research.

II. A. **Funding Schedule:** ADVANCED METALLURGICAL PROCESSES (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
Advanced Metallurgical Processes	<u>\$5,000</u>	<u>\$4,965</u>	<u>\$5,000</u>	<u>\$35</u>	<u>1%</u>
Total, Advanced Metallurgical Processes	<u>\$5,000</u>	<u>\$4,965</u>	<u>\$5,000</u>	<u>\$35</u>	<u>1%</u>

II. B. **Laboratory and Facility Funding Schedule**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$Change</u>	<u>%Change</u>
All Other	<u>\$5,000</u>	<u>\$4,965</u>	<u>\$5,000</u>	<u>\$35</u>	<u>1%</u>
Total, Advanced Metallurgical Processes	<u>\$5,000</u>	<u>\$4,965</u>	<u>\$5,000</u>	<u>\$35</u>	<u>1%</u>

III. **Performance Summary:**

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Metallurgical Processes	Continue research focused on conservation of natural resources through extending the service life of materials or finding substitute materials and processing paths for those that are environmentally hazardous. Continue research efforts in partnership with industry and with State and Federal agencies to build viable domestic commercial capabilities in waste-free, environmentally benign	Continue research focused on conservation of natural resources through extending the service life of materials or finding substitute materials and processing paths for those that are environmentally hazardous. Continue research efforts in partnership with industry and with State and Federal agencies to build viable domestic commercial capabilities in waste-free, environmentally benign	Initiate research identified during FY 1998 to contribute to Fossil Energy's Vision XXI Power Plant Focus areas to include reducing greenhouse gas emissions through CO ₂ sequestration and partnerships for implementing improved efficiency technology, energy production system by-product processing and materials development. Continue research efforts in partnership with industry

III. **Performance Summary**: ADVANCED METALLURGICAL PROCESSES (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Metallurgical Processes (Cont'd)	metal alloy production, joining, and forming. Continue research related to corrosion of infrastructure and efforts to achieve better understanding of wear, corrosion, and fracture, resulting in an improved understanding of materials structure and properties for better performance. Continue cooperative research with funding from the Environmental Protection Agency (EPA) to develop environmentally benign processes for the metal forming industries. Develop a continuous casting process for lightweight titanium. Begin crosscut research identified during FY 1996 to complement Fossil Energy R&D objectives. (\$4,950) (ARC)	metal alloy production, joining, and forming. Continue research related to corrosion of infrastructure and efforts to achieve better understanding of wear, corrosion, and fracture, resulting in an improved understanding of materials structure and properties for better performance. Develop a continuous casting process for lightweight titanium. Begin crosscut research identified during FY 1996 to complement Fossil Energy R&D objectives. (\$4,915) (ARC)	and with State and Federal agencies to build viable domestic commercial capabilities in waste-free environmentally benign materials production. Continue research efforts to achieve better understanding of wear, corrosion, and fracture, resulting in an improved understanding of component structure and properties for better performance in mining and processing of coal and in Vision XXI Power Plant components. Develop a continuous casting process for lightweight titanium for gas and oil industry applications. (\$4,950) (ARC)
	Fund technical and program management support. (\$50)	Fund technical and program management support. (\$50)	Fund technical and program management support. (\$50)
	\$5,000	\$4,965	\$5,000

III. **Performance Summary**: ADVANCED METALLURGICAL PROCESSES (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Advanced Metallurgical Processes, Total	\$5,000	\$4,965	\$5,000
